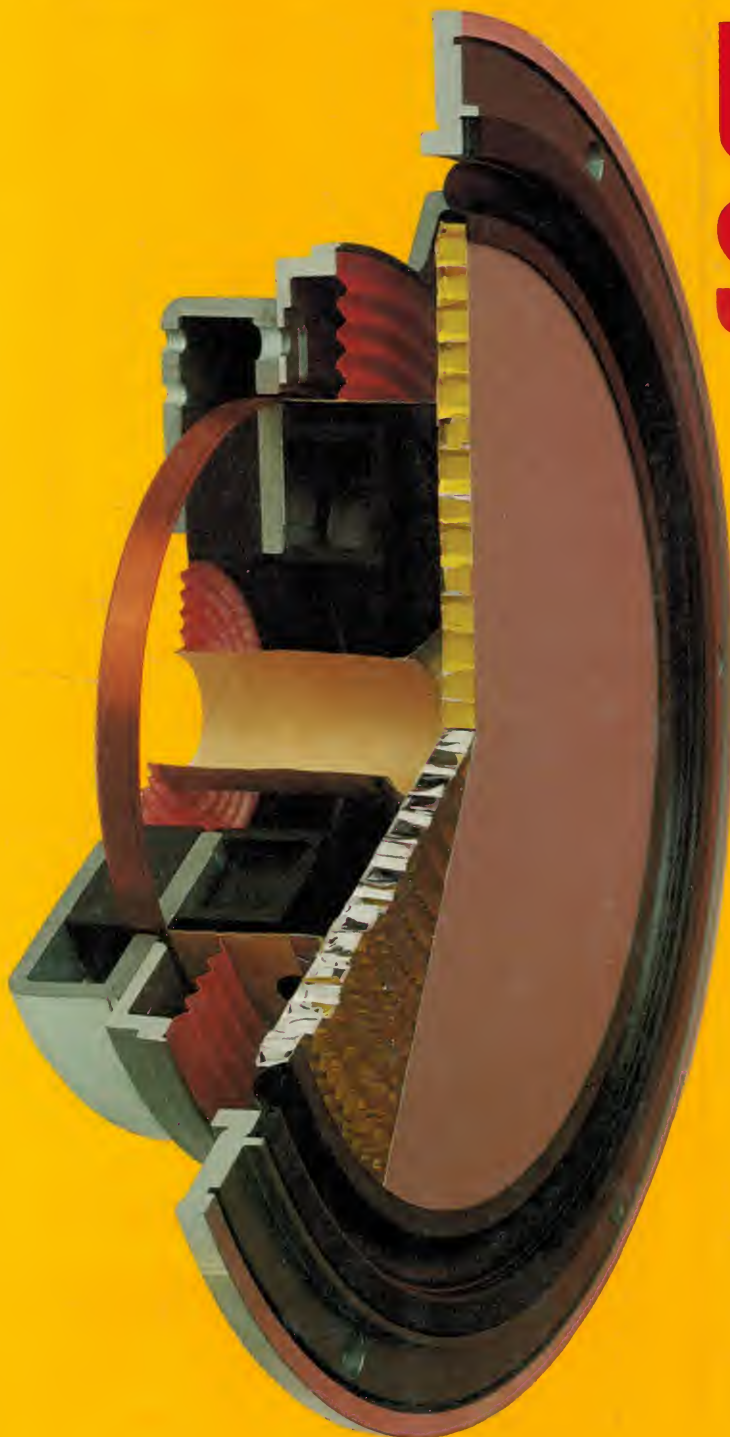


JULY 1981 \$1.75* NZ \$2

eti

**ELECTRONICS
TODAY
INTERNATIONAL**

**BONE FONE
STEREO RADIO**
—SPECIAL READER OFFER



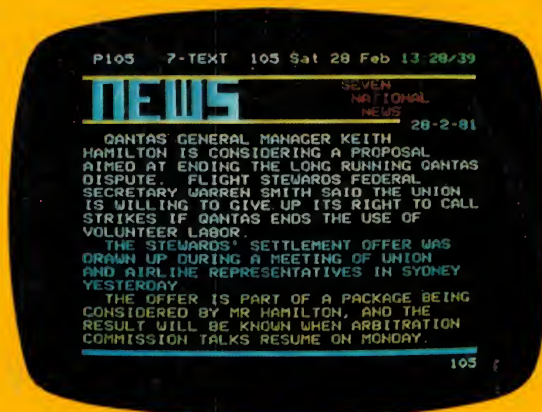
UNIQUE SPEAKERS

**Technics SB10s
examined in detail**

BUILD A CAR ALARM

With exit/entry delay

System 80 reviewed



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ADDITIONS TO 'THE FAMILY'

THESE PAST FEW WEEKS have seen the culmination of some nine months or more of planning and production effort here with the launch of not one, but **two** new magazines from the ETI group. First off the rank was COMDEC Business Computer Magazine. This publication will be of special interest to many ETI readers as well as people you undoubtedly know who need or want to know about computers but are unfamiliar with the jargon and the technicalities. COMDEC is written in **English** — probably a first for a magazine of this type! This first issue is the 1981/82 Yearbook and contains a range of feature articles covering many aspects of choosing and using computer systems, from 'personal' micros through to the larger minicomputer systems. Many ETI readers will be particularly interested in the directory sections at the rear, which list who sells what and specialist companies. Our announcement on page 81 will tell you a little more about it.

Our second new publication we feel fulfils a long-felt need. **Hobby Electronics** is its name ('son of ETI' to the irreverent) and this magazine is intended for the newcomer or 'non-expert'. Projects are a big feature of Hobby Electronics and Editor William Fisher plans to present four every month along with 'learning' features about components and construction techniques. In addition, the magazine will include articles on broader topics such as AM radio, hobby computing and CB radio, etc. More information is given in our News Digest feature on page 8.

We've long felt there was a need for a 'simpler' electronics publication in Australia and have felt frustrated that we could not properly cater for newcomers to the hobby within the pages of ETI. We have to appeal to a very wide spectrum of readers and because of this, many newcomers and others not so advanced in their hobby were, we felt, 'put off' because much of the material was above their heads. Economics dictates that there's only a limited amount of space available within the magazine each month that can be devoted to these readers, so we hope Hobby Electronics solves that problem. Almost every electronics hobbyist knows another who is a beginner or a dabbler. We recommend you draw their attention to Hobby Electronics.

Roger Harrison
Editor



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SIGHT & SOUND

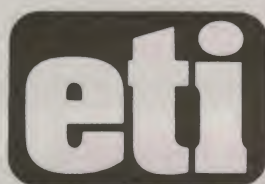
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**ELECTRONICS
TODAY
INTERNATIONAL**



COVER

Technics new range of loudspeakers clearly benefits from new design approaches — as Louis Challis' review in this issue testifies. Cover photograph courtesy National Panasonic. It's a cutaway view of the 320 mm woofer Technics developed for their new speaker range.

*Recommended retail price only.

NOTICE: The ETI-660 Learners' Microcomputer has been held over owing to a number of difficulties beyond our control. We apologise for any disappointment and trust you understand.

news

NEWS DIGEST

'Hobby Electronics' — new magazine for beginners; Electric vehicles; New reference books; Solar cell sun tracker; and more.

PRINTOUT

Australian single-board computer; The Z80 — naked at last; For Sorcerer apprentices; Commodore advisory programme for schools; etc.

COMMUNICATIONS NEWS

Sky Ace available again; Digital storage RF spectrum analyser; etc.

features



RADAR FOR THE BLIND

14

Until technology can produce 'synthetic vision', the sonic torch may be the most practical method for blind people to move more freely around their environment.

SUPERCONDUCTING MAGNETIC SENSORS

22

Scientists at an IBM research centre have constructed experimental superconducting magnetic sensing devices whose operating characteristics approach limits imposed by fundamental laws of physics.



RADOFIN TELETEXT CONTEST

38

Win a Radofin Adam 180 Teletext adaptor in this simple competition! Features of the Adam 180 include handheld remote control, presettable switch-on, adaptability to any colour or B&W TV set, and many more. Don't miss out!

computing

COMPUTING TODAY

81

Introducing a computer magazine for non-experts written in an amazing new computer language — English; Understanding and using computer graphics; Dicker Data to supply navy.

TOUCH TYPING TUTOR

90

Touch typing is a skill which, however useful, eludes most computer hobbyists. Here's how to program your computer to help you to learn to touch type.



DICK SMITH SYSTEM 80 — REVIEW

93

The System 80 Mark II was recently released by Dick Smith Electronics, and seems to be settling down to a position amongst the top sellers in the 'middle range' home computer market. Phil Cohen takes a closer look at it.

SPELLGUARD — EVERY PROOFREADER'S DREAM!

98

Spellguard is a software system for use with microcomputers that proofreads a text file typed into a word processor or text editor. Elaine Ray takes a look at it.

ADVANCED BASIC: PART II — CHAINING

105

The second in Phil Cohen's series on advanced BASIC programming, this month's article looks at 'chaining', with example programs and flowcharts.

projects

SERIES 5000 PREAMPLIFIER

25

Designed as the 'perfect partner' to our Series 5000 MOSFET stereo amplifier, this preamp offers many unique features.



330: CAR ALARM

31

This 'current trip' car alarm features exit/entry delay and no false alarms. It uses the battery earth strap as a sensor and involves only simple circuitry.

258: MINI-DRILL CONTROLLER

47

This simple circuit fixes the usual drawback with mini-drills — their poor speed regulation under load.

154: LOGIC PULSER PROBE

53

The logic probe is one of the most useful and convenient test instruments for designing and trouble-shooting digital circuitry. A five-mode logic pulser in conjunction with the probe makes it just about the perfect test instrument!

sight & sound

SIGHT & SOUND NEWS

111

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SPECIAL OFFER — BONE FONE

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TECHNICS' SB-10 LOUDSPEAKER REVIEW

122

Louis Challis gives the SB-10 speakers the accolade of being "the finest Japanese loudspeakers I have yet heard". What more is there to say?

SERIES 4000 LOUDSPEAKERS — A PERSONAL REVAMP

131

A reader, Garth Pennington, has constructed a pair of ETI Series 4000 speakers adding concrete damping and extra bracing. He was very pleased with the results.

PIONEER TX-710 TUNER

140

Louis Challis found that the Pioneer TX-710, one of the new breed of Japanese FM tuners, gave excellent FM reception out of a simple, uncluttered design.

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MINI-MART

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next month



ELECTRONIC DISTANCE MEASUREMENT

Until recently, electronic distance measuring instruments have mainly benefited land surveyors. Hewlett Packard have developed an instrument that measures distance to both stationary and moving targets using an optoelectronic technique employing an infrared light beam. This article explains the technique.

COMPUTER SPECIAL

Data '81 is the name of this year's Computer Exhibition — the largest annual exhibition of its kind in Australia. Our feature gives a rundown on what's new and who's who this year in the world of computers and computing.

ALPHASORT PROGRAM

Sorting information alphabetically is one of the most common requirements of file handling and data sorting. You can arrange your printout with this program and never lose track of that special lady's phone number again!

AUDIO-TECHNICA ATH-8 HEADPHONES

What with all the trumpeting about loudspeakers recently, one would have thought headphones were a dying breed. Not so! This recently released model from Audio Technica is a top-line, top price set of 'phones that Louis Challis considers "... offer a standard of fidelity, total frequency response and other acoustical attributes for which many audiophiles have long aspired but could not otherwise afford."

REMOTE CONTROL SYSTEMS

Multi-channel remote control systems have many applications outside the radio control of models. Ray Marston describes and discusses a variety of circuits that you may find useful — all using commonly available components.

Although these articles are in an advanced state of preparation, circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.

DICK SMITH NEW ZEALAND RETAIL STORE NOW OPEN!

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If you're into electronics, or a hobbyist, and you want an economical, reliable multimeter, this is the one for you! Offers the normal measurements plus high sensitivity. Why pay more!

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Hobby Electronics blasts off!

Forget the space shuttle, the launch of the year was definitely that of ETI's protege, Hobby Electronics!

The new magazine took off precisely on schedule, and according to mission control it's 'right on target'.

Hobby Electronics is aimed at everyone who's interested in electronics, but isn't yet expert enough to feel comfortable with any of the existing electronics magazines.

Some readers will already know a bit of electronics, others will be complete beginners.

Editor William Fisher makes it clear that, "This won't just be a gee-whiz sightseeing tour.

"Sure, our readers are going to be excited and enthralled a lot of the time, but they're also going to learn a lot, both practically and theoretically, from our projects and features."

Fisher, a lean 33-year-old refugee from the British Isles, is quietly confident of success. Hobby Electronics is his first independent command, but he has a solid background in magazine publishing. A physics graduate, he trained as a technical writer in the UK with the huge Marshall Cavendish publishing house and came to Australia in 1979. He joined ETI's staff in May 1980.

He takes his job seriously, but he has a sense of humour, too. Asked to substantiate his claim to have the 'world's fastest-growing magazine', he pointed out that sales of the first issue of Hobby Electronics represented an infinite percentage increase on the previous month's zero figure!

Four projects are presented every month in Hobby Electronics.

The opening issue featured a Radio Microphone, AM Tuner, Transistor Tester and Bench Amplifier.

The August issue follows up

with a Guitar Phaser, Power Supply, Electronic Die and Extra Flash Trigger.

The aim with all projects is to keep them as easy and cheap to build as possible, with one proviso — the design must be utterly reliable.

Feature articles cover a wide range. For beginners there's a series explaining the functions of fundamental components. The July issue discussed capacitors; diodes are on the menu for August.

For more advanced readers there are articles about how common electronic functions are performed. Op-amps were the subject in the first issue and August introduces oscillators.

Then for general interest there are features on broader subjects, like AM radio and metal detectors in the first issue.

From time to time in Hobby Electronics there will also be articles about activities which have grown out of electronics but are not exactly part of it. The July issue kicked off with an introduction to hobby computing, August introduces CB radio, and the joys of shortwave DX will be explained in the near future.

Hobby Electronics has introduced a new service to the leisure electronics industry. Kit and component suppliers get information on an issue's projects two months in advance so that pc boards, parts and kits will be in the shops when the issue goes on sale. Article reprints are also available from suppliers.

Hobby Electronics is aimed at the beginner in electronics — be he 5 or 50 — and is written throughout in language the beginner can understand. It costs just 95 cents, available through all newsagents plus selected electronics stores.

Hobby Electronics
AN ETI PUBLICATION

95c
NZ \$1.25

RADIO MICROPHONE

One of 4 great projects to build



CHOOSING A HOBBY COMPUTER
- read our guide before you buy!

HOW THEY WORK — fascinating
features on Metal Detectors,
AM Radio, Capacitors, Op-amps

Win all the tools you need from
JAYCAR
see page 10

Look for the first issue of Hobby Electronics in your newsagent now!

Red for danger?

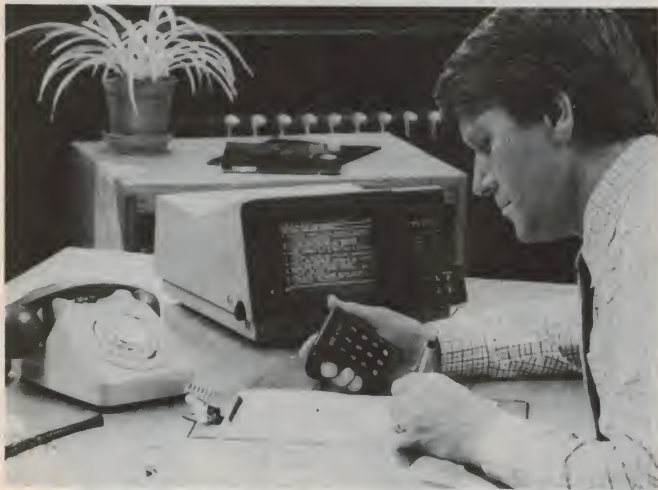
The Natron Multi-colour Digital Panel Meter (CDPM) is designed to give clear and quick indication of readouts below or in excess of critical limits by changing the colour of its digits.

The input levels at which the colours need to change can be set by adjusting trimmer potentiometers, accessible by removal of the snap-off bezel.

Standard colours are green, yellow and red, but other colours can be substituted on request (for volume requirements) and the sequence of colour changes can be arranged as specified.

The CDPM could be of use to indicate critical parameters in medical electronics, remote control of oil, gas, water and electricity supply systems, and for industrial processes.

For further information contact Technico Electronics, P.O. Box 50, Lane Cove NSW 2066, or P.O. Box 520, Clayton Vic. 3168.



Videotex in 1982?

1982 has been tentatively scheduled by Telecom for the introduction of Videotex, a public information network which will give Australians armchair access to massive databanks through the domestic TV set and telephone.

Modified TVs with a video adaptor and a calculator-like keypad will give access to information ranging from simple news and weather reports to travel timetables and fares, restaurant profiles including menus and prices, entertainment and sports directories, city guides, the latest gold and share market dealings, etc, etc.

The consumer will be able to reply to the information on the screen by keying into a response frame on the page to make an airline booking, hotel or theatre reservation, etc, from the comfort of the living room.

The databases will be pro-

vided by companies or individuals, who will pay Telecom for the privilege, and although searching the indexes will cost the consumer nothing, once the information file is reached costs start to accrue based on a charge per page of information and an hourly computer connection fee. The final cost of this will reach you on your telephone account.

Services should open first in Sydney and Melbourne, with one central computer complex hosting four minicomputers and multiplexing to provide interstate services, all at local telephone charges.

Probe gives multimeter a temperature output

Digitron Instrumentation of the UK recently introduced a pushbutton-operated probe to convert virtually any analogue or digital multimeter into an accurate temperature indicator.

Known as the 600 Series, the probes are offered in versions for millivolt or microamp output in the -25°C to $+350^{\circ}\text{C}$ temperature range. Two standard probes are available: Type 2 for liquids, semi-solids, air, gas, granular materials and

plastics; Type 4 for surface measurements.

For further information contact the Australian agent, Pacific Communications Pty Ltd, 4 Euston St, Rydalmere NSW 2116.

Immediate-response DMM

The Avometer Auto DA117 digital multimeter is claimed to have response times of less than 1 s for dc (voltage or current) and resistance ranges, and less than 3 s for ac ranges.

The multimeter can be operated by four 1.5 V dry cells for dc and ac voltage ranges of 200 mV, 2 V, 20 V, 200 V, or 1000 V; dc and ac current ranges of 200 μA , 2 mA, 20 mA, 2 A, or 10 A; and resistance ranges of 200 ohms, 2 k, 20 k, 200 k, 2 M or 20 M.

Readout is on LCDs, and changeover from auto-ranging to manual is at the touch of a button. The instrument is

portable, and measures approximately 185 mm x 145 mm x 85 mm. It is supplied complete with leads, prods and insulated clips, a 20 mm high-top cover to house the leads, a fuse-removing key and two spare fuses.

Contact the Australian agent, Electrical Equipment Ltd, Industrial Division, P.O. Box 210, Arncliffe NSW 2205, for more information.

New Natsemi regulator offers highest output power

The LM196 is a 10 A monolithic adjustable voltage regulator manufactured with National Semiconductor's revolutionary MOOSE process, which is said to offer the highest output power available.

This process combines standard linear bipolar technology with high-power discrete transistor techniques, resulting in a 2:1 reduction in die size, plus significant improvements in efficiency, according to National.

The LM196 is said to have performance features equal to or better than existing lower power IC regulators, specifically: internal reference is trimmed on-chip to better than 1% accuracy, which simultaneously reduces temperature drift to a typical value of 0.003%/°C; TC is guaranteed to 0.01%; maximum



junction temperature is 200°C in the power transistor; 45 W power dissipation at a case temperature of 125°C .

For further information contact Ed Schoell (03) 729-6333 or Chris Mason (02) 439-6455.

NOTE ON THE CORE-BALANCE RELAY ETI-567

A reader has drawn to our attention a problem he experienced when using the core-balance relay with a long lead plugged into its output where a number of fluorescent lights were operating nearby. The core-balance relay would not trip on test with loads over about 25 watts. On investigation, he found severe RF noise generated by the fluorescent lights was preventing the unit's trip circuit from functioning. Looking at each end of L3 (secondary of T2, the sense transformer) using an oscilloscope, he found high amplitude noise on each, but of markedly differing amplitudes. The cure is simple — a 4n7 capacitor connected directly across L3. The unit still functions as designed, even with highly inductive loads plugged into the output. Our thanks to Bill Waters for passing that on.

Electric vehicles — for governments and people!

The first electric vehicle to be tested for use by the NSW State Government, a van manufactured by Silent Power Pty Ltd, was recently delivered to the NSW Energy Authority.

The NSW Government will eventually receive nine electric vehicles as part of its Electric Vehicle Programme, designed to rationalise and conserve energy within government departments. Electric vehicles are being considered particularly for application in short-distance delivery situations.

The Silent Power van can be equipped to seat four people or two people and a small cargo. It has a range of 40-45 km or more in a single battery charge, and is powered by the mains electricity supply of 240 V. It is recharged by connecting the power source to a socket at the rear of the vehicle.

Meanwhile, up on the Gold Coast Vic Jones, a retired salvage operator, has become the first private individual in Queensland to own an electric vehicle. He bought the Silent Power van because he felt that someone had to be a 'trend-setter' and bring an alternative

energy source into the realm of private life.

The South East Queensland Electricity Board has been in close liaison with Mr Jones, and has agreed to provide technical advice and assistance regarding the van; it will also install a separate metered power point so that exactly how much electricity the van uses can be measured.

Vic Jones is so far extremely pleased with the performance of his electric van, in particular with the on-board battery charge, which allows him to charge up at any power point. He said of the vehicle, "It is smooth, silent and has plenty of power in traffic. It is beautifully finished, the driver's vision is good, and it has all the comforts and luxuries of a petrol car."

The vehicle will eventually be equipped with longer range batteries, which will make it eminently suitable for Gold Coast/Brisbane travel, according to the SEQEB.



According to Vic Jones, nothing can beat this 'plug-in' transportation.

Hitachi probes deeper

Hitachi Denshi Ltd have recently released a new probe, AT 100 AG 1.5, as an accessory for their range of oscilloscopes.

The AT 100 AG 1.5 is a 100 to 1 and 10 to 1 switchable device usable up to 35 MHz. The input impedance is 100 Mohm on 100 to 1 and 10 Mohm on 10 to 1 setting. It is rated at 1000 Vdc, and is fitted with a 1.5m cable and BNC connector.

Hitachi reckon that this new probe will be particularly useful to field technicians, laboratory engineers and TV servicemen.

The probe is available from Standard Components Pty Ltd, 10 Hill St, Leichhardt NSW 2040, for \$76 plus tax.

Books for the student, or your reference library

Two recent releases from the McGraw-Hill Book Company Australia Pty Ltd should be of interest to students embarking on an electrical trades or electronics/communications trades course.

Both books would also be valuable reference works for the keen hobbyist, experimenter or radio amateur.

Electrical Principles for the Electrical Trades by J.R. Jennison, a lecturer at the Regency Park Community College, South Australia, is the theory text recommended Australia-wide by the National Core Syllabus Committee in Electrical Trades. The book consists of seventeen chapters, covering units and physical quantities, fundamentals of electricity, primary and

secondary cells, dc circuit analysis, magnetism, electromagnetic effects, generation of emf, dc machines, fundamentals of alternating current, ac circuit analysis, multi-phase generation and distribution, three-phase synchronous machines, three-phase induction motors, single-phase motors, transformers, rectifiers and filter circuits and electrical measuring instruments. Also included are exercises, problems and mathematical tables.

The text is well written and clearly set out. The subject

treatment is traditional (starting at the electric charge and the structure of matter, etc). The text is copiously and clearly illustrated using both photographs and line drawings. The book is 378 pages long and bound with a stiff card cover. It measures 210 x 280 mm. Price is \$9.95.

Electrical and Electronic Drawing by James F. Lowe, head teacher of Electrical Trades at the Newcastle Technical College, is a somewhat smaller tome running to 198 pages in a 182 x 240 mm format with a heavy card cover. It is the third book in a series of three on drawing and drawing techniques for electrical and electronics students.

The text of Lowe's book is also very thorough and clearly

written. He has made copious and effective use of photographic illustrations along with line drawings and second colour. Practical examples are used to illustrate various techniques of drawing and design. Some knowledge of electrical and electronic principles is assumed, but background to the processes of which the drawings are part and parcel is explained in detail. An informative text, it covers units 23 to 33 inclusive of the relevant course. It introduces students to ink drawings and techniques and covers four broad areas of electrical drawing design: motor starter and controller diagrams, switchboard layout and wiring diagrams, electronic circuit drawing and design, and printed circuit artwork production.

Energetic water?

The world's cleanest fuel, hydrogen, could be produced from one of the planet's most abundant resources — water — if scientists can find a cheap and reliable method of extracting it using the energy of the sunlight.

The CSIRO's Division of Applied Organic Chemistry in Melbourne is engaged in a study of recently discovered combinations of chemical compounds which cause hydrogen bubbles to form in water under the action of light.

The key compounds act as catalysts; they trigger the production of hydrogen from water using light energy, but are not involved in the chemical reaction themselves, and in theory should therefore last almost indefinitely. The CSIRO team specialises in finding out why the reality does not match up to the theory — why the formation of hydrogen eventually stops.

The only other energy source

with similar potential is fusion power, which aims to duplicate the nuclear reaction which powers the sun. Like fusion power, hydrogen energy is not expected to provide a short-term solution to the world's energy problems, but one advantage of hydrogen energy is that it can replace fuels such as petroleum and natural gas in engines and power stations without the radical changes in existing technology required for nuclear fusion.

Another advantage of hydrogen is that when it is burned it turns back into water, thus virtually eliminating the pollution problems associated with most other fuels.

Christie Rand to distribute Sabtronics International products

Following the appointment of Christie Rand Pty Ltd of Sydney as sole distributor for Sabtronics International, Christie Rand have the following products for sale in either assembled or kit form (they say kits can be easily built within one evening):

- 0.1% Digital Multimeter 2010 — this measures dc and ac voltage in five ranges from 100 μ V to 1000 V, with 0.1% accuracy on dc and 0.55% accuracy on ac. On dc and ac current there is similar accuracy, with measurement in six ranges from 100 nA to 10 A. The 2010 has several other useful features, and costs \$138 including tax in kit form and \$161 including tax assembled.

- 600 MHz Frequency Counter 8610 guarantees 10 Hz to 600 MHz, with a claimed typical performance of 5 Hz to 750 MHz. Its price is \$202.40 with tax for the kit, \$225.40 assembled.

Christie Rand also expects to

be marketing the following items in the near future:

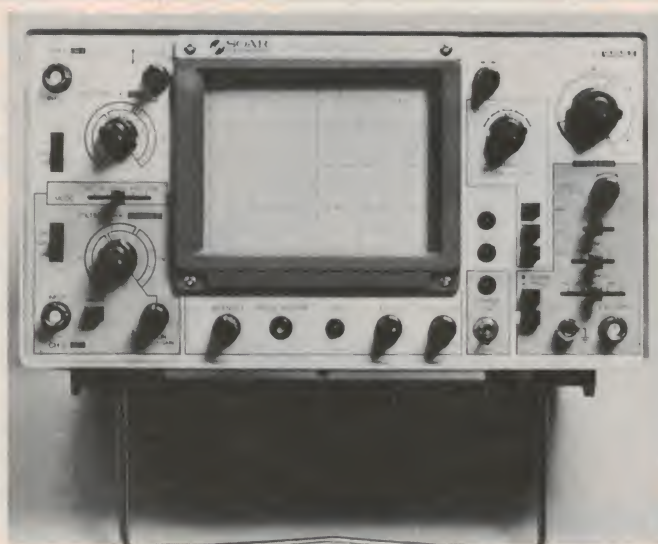
- 1 GHz Frequency Counter 8000 — the 15 mV - 30 mV sensitivity will resolve 10 Hz at 1 GHz, with an aging rate of ± 5 ppm/year. Price for the kit will be \$534.75 including tax, assembled \$563.50 including tax.

- Function Generator 5020: the specifications are for 1 Hz to 200 kHz in five ranges, sine, square and triangle wave. It costs \$230 in kit form including tax, \$253 assembled.

For information on any of these products contact Christie Rand Pty Ltd, P.O. Box 48, Epping NSW 2121. (02) 477-5494.

ERRATA

A rather obvious, but potentially dangerous error occurred in the circuit on the top left of page 60 ('Power Monitor') in the March issue. It shows the mains active input connected to the earth at the output. The mains active input should instead go to the fuse. Correct your copy now. Correction slips were inserted in the majority of copies distributed.



New range of Japanese oscilloscopes soon available

GFS Electronics of Victoria have announced the imminent release of a range of five oscilloscopes, including a portable, from the Japanese SOAR Corporation.

All models use rectangular CRO tubes with a built-in graticule, which gives high resolution and brightness with a minimum of parallax error; all are dual trace and supplied with dual x1 and x10 probes. A front-panel-mounted trace rotation control is fitted to allow easy compensation for variation in

terrestrial magnetism.

The models in the range are the MS-3015 (a portable), MS-6020, MS-6021, MS-6040 and MS-6045.

For further information contact GFS Electronic Imports, 15 McKeon Rd, Mitcham Vic. 3132. (03)873-3939.

Solar cell sun tracker

A novel tracking device that locates the sun and controls drive motors to keep a solar collector facing it has been invented by Burrell E. Hammons of Sandia National Laboratories, Albuquerque, New Mexico.

The device's shape partially shades four of eight small solar cells mounted on the sides and the base of a small, square pedestal when the solar collector is properly oriented to the sun. Until this spot is reached, unequal voltages from the cells cause the drive motors to move the solar collector until the voltages are equalised.

A ninth cell, mounted atop the pedestal, deactivates the tracking mechanism when the sun is obscured.

The simple and inexpensive device boasts unmatched tracking accuracy on a clear day — to



better than $\pm 0.1^\circ$ — and the ability to find the sun even when the collector is facing away from it.



Temperature-controlled soldering station from Weller

Claimed to be technologically the most advanced soldering station on the market, the Weller EC2000D has been released by the Cooper Tool Group.

Tip temperature range from 175°C to 450°C may be selected and locked at any desired temperature by the operator. Actual tip operating temperature is displayed on a three-digit LED digital display to within 1°C.

Innovative technology ensures that the tip temperature is maintained at the desired setting.

The EC2000D is ideal for delicate and precision soldering applications and where continuous use is necessary. Soldering pencils are interchangeable without recalibration of the

temperature setting, allowing complete versatility in use.

Safety features of the EC2000D include a circuit breaker to prevent overloading, non-burning rubber silicone iron cord, ceramic-filled iron elements for long life and durability, and an unbreakable, high-impact flame retardant plastic housing.

For further information contact a Weller distributor or the Albury sales office of the Cooper Tool Group at P.O. Box 366, Albury NSW 2640. (060) 21-6866.

Intelsat to purchase more satellites

With the first of its Intelsat V satellites only launched on December 6 1980, the Intelsat organisation has decided to purchase three advanced Intelsat V-A satellites. These will be in addition to the nine satellites planned in the Intelsat V series.

According to Intelsat, the new satellites will be required to enable the organisation to cope with the world demand for satellite communications, which is doubling every three or four years.

The Intelsat V-As will be basically similar to the Vs, but will incorporate modifications and improvements to increase reliability and boost their com-

munications carrying capacity by 25% — from 12 000 to about 15 000 simultaneous telephone calls plus two television programmes.

The cost of the three satellites, to be manufactured by Ford Aerospace and Communications Corporation and an international team of contractors, will be approximately US\$100 million.

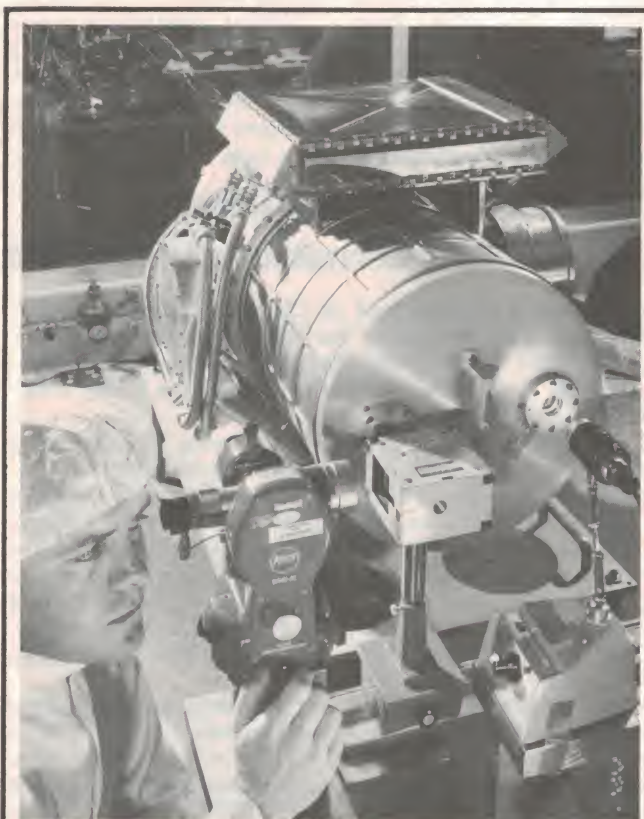
Sky spy!

As Europe's first authority to do so, West Germany's post office, the Bundespost, has started a radio-monitoring service that keeps tabs on satellite-based transmitters from a ground terminal in Leeheim, near Frankfurt.

A Siemens-built antenna system spots, tracks and identifies communications satellites and determines their orbits and their transmitters' frequency, polarisation, and radiated power.

With the increasing number of communications satellites aloft — around 200 at present — this monitoring task is becoming more and more important to ensure that satellite operators keep the transmitters adjusted to the assigned specifications and thus to prevent interference with other radio communications.

In its present configuration, the Leeheim antenna system monitors three frequency ranges: from 130 MHz to 1.3 GHz, from 1.5 to 2.3 GHz, and from 10.95 to 11.8 GHz. Later, the system will cover the entire 130 MHz to 13 GHz range.



INFRARED SENSOR TO DETECT MISSILES IN SPACE

An optical engineer carries out final checks on a new type of infrared sensing spacecraft, soon to be sent to an altitude of about 100 nautical miles, from where it will scan a wide area of space. Its main purpose will be to detect and track ballistic missiles by the infrared radiation they emit and so to provide as early a warning as possible of any such missile launch.

When the sensor has carried out its work it will fall into the sea after a slow parachute descent, from where it will be recovered to be used again.

The sensor has been developed by Hughes Aircraft Company, California, under contract to Boeing Aerospace, and will form part of a US Army programme.



fact: dramatic freedom from distortion comes to a mid-priced cartridge: the new Shure M95HE...



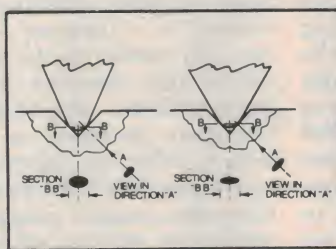
an affordable, audible improvement

One of the critically acclaimed advances introduced in Shure's incomparable V15 Type IV pickup is its revolutionary and unique distortion-reducing Hyperelliptical stylus. Now, you can enjoy this standard of sound purity in a new, ultra-flat frequency response, light tracking, high trackability cartridge that will not tax your budget: the new Shure Model M95HE.

the Hyperelliptical stylus tip

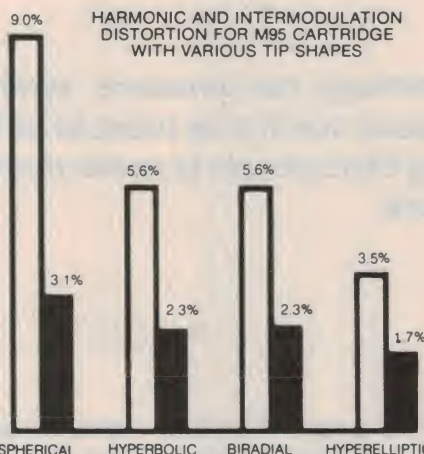


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HYPERELLIPTICAL
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The Hyperelliptical nude diamond tip configuration represents a significant advance in tip design for stereo sound reproduction. As the figures show, its "footprint" (represented by black oval) is longer and narrower than the traditional Biradial (Elliptical) tip-groove contact area. Because the Hyperelliptical footprint geometry is narrower than both the Biradial and long-contact shapes such as the Hyperbolic, it is pre-eminent for reproduction of the stereo-cut groove.



□ Second harmonic distortion
Average both channels, 8 kHz,
5 cm/sec peak recorded velocity
■ Intermodulation distortion
Average both channels,
1 kHz/1.5 kHz

a measurable drop in distortion

As a result of the optimized contact area of the Hyperelliptical tip, both harmonic distortion (white bars in graph above) and intermodulation distortion (black bars) are dramatically reduced.

upgrade your present M95 If you already have a Shure M95 Series Cartridge, you can improve its freedom from distortion right up to the standards of the new M95HE cartridge simply by equipping it with a Model N95HE stylus. The cost is extraordinarily low — yet the difference in sound will be immediately apparent. Takes only seconds to install — requires no tools whatsoever.

M95HE cartridge & N95HE stylus



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Radar for the blind

James W. Park

Until technology can produce 'synthetic vision' for the blind, the sonic torch may prove to be the practical answer to enabling blind people to move more freely around their environment.



THE ABILITY to sense the environment accurately, particularly within an immediate neighbourhood of around five metres, is a prerequisite of the mobility and lifestyle of the higher animals, including man. In man and many of the primates the sense of sight is the most important of the senses providing information about the environment; hence the incapacitation and relative helplessness of the blind.

Other species of mammals, however, rely chiefly on different senses, and in considering the problems of the blind the bat becomes particularly relevant.

Most species of bats are totally blind in the visual sense, but achieve an awareness of their surroundings in great detail by emitting high frequency sounds (many of them above the frequency range of human audibility) and listening to the echoes received from nearby objects. In the ocean dolphins and whales also use sophisticated high frequency echo-location, although aided by actual vision.

In this electronic age it is not too difficult to see the possibilities for the blind in an adaptation of this 'sounding' system for recognising the environment. As a principle, using radio waves, radar has been developed over the past forty years, mainly for locating the position of aircraft and ships, so echo-location for the blind is not drawing on totally innovative ideas.

In adapting the principles of radar as an aid for the blind it became apparent

that over the short distances involved (less than ten metres), sound waves of ultrasonic frequency, say in the range of 20 kHz to 100 kHz, were more convenient than radio waves. This is mainly because of the much lower speed of propagation of sound waves — 340 metres per second as compared with 300 million m/sec for radio waves. The method of echo-location using ultrasound is therefore similar to that used by the bat except that the echoes have to be translated into frequencies audible to the human ear.

The most practical and cost-effective way of converting the bat's sounding system to human use has proved to be the 'sonic torch'. The first commercially produced device was developed by Ultra Electronics in the UK, and about 1000 of these units were manufactured before it went out of production. Now an improved 'torch' has been developed in Melbourne, called the Radarsonic Lantern.

Weighing less than 350 g, the Lantern is hand-held like a normal torch. A beam of ultrasonic energy radiates from the front of the unit, much like the beam from a flashlight, and the small fraction of this energy reflected from objects in the path of the beam is detected and converted into audible sound in a listening device worn either in the ear or on the lapel.

The sound heard takes the form of a series of 'beeps', each lasting a quarter of a second and separated by a silent

period of about 20 milliseconds (.02 sec). If the Lantern is pointed directly towards a hard, flat surface like a door or a plate-glass window a few feet away, the beeps are heard as strong, pure tones. The pitch or frequency of the tones is a direct measure of the distance separating the Lantern from the reflecting object.

A blind person can therefore determine the lateral separation of objects in his vicinity by sweeping the 'direction of gaze' of the instrument either vertically or horizontally. The beam is fairly directional, having a width of ± 8 degrees — 16 degrees in total. By combining the information obtained from sweeping or scanning the beam with the pitch of the beeps (beep frequency decreases as the distance from a reflecting object decreases and vice-versa), the blind user can obtain a three-dimensional picture of his environment, with a range from about 10 mm to 6 m.

Further differentiation of the surroundings is provided by the variation of the beeps. They are not always heard simply as pure audio tones, but for different reflecting surfaces take the form of chirps, tweets, warbles, swishes, etc. With experience the blind person can learn to distinguish between many different features of his environment.

A blind American, Fred Gissoni, experienced in the use of a sonic torch, clearly describes the effectiveness of this aid to the blind:

"Once, while demonstrating the use of the aid in a room which was totally unfamiliar to me, I was asked to walk about the room describing objects that I found. I was able to walk about finding clear aisles, chairs and doorways. Suddenly near the centre of the room I found an object which gave a most curious set of signals. Against my better judgment I described the object as giving the impression of being a table but at the same time having a fence in the middle of it. This description was greeted with a combination of laughter and applause. The object I was examining was a ping-pong table.

"Another time, again in an area which I was visiting for the first time, I was asked to point the aid at an object and describe what I observed. After a few seconds I said that the impression I received was of a rock fence with foliage sticking through it. Upon examining the object by touch I found it to be just that: a rock fence with foliage sticking through it."

Gissoni also describes how he developed a memory bank of sounds, not necessarily restricted to the sound of an individual beep. For example, when standing at the foot of a flight of steps and scanning the beam upwards, the frequency of the signal increases in steps (rather like a musical scale), and this kind of effect is soon memorised.

When walking at a normal pace and carrying the aid in a natural position so that it points forwards, all stationary objects in the path of the beam will cause the pitch of the beeps to fall with closer approach. The presence of a constant frequency signal in this situation could indicate another pedestrian walking ahead at the same pace, and of course the absolute pitch of this signal would indicate how far away he or she was.

Better than such written examples of the use of the Lantern are tape-recorded demonstrations or, best of all, actually listening to the signal while handling the Lantern. The blind are therefore best trained to use the device by an interested sighted person, using a set of printed instructions supplied with each unit. There are 16 illustrated lessons, each an hour long, and the sighted instructor simply directs the blind pupil through a series of exercises of increasing difficulty.

After the first quarter of an hour the blind person can already use the aid as a simple obstacle detector, and after ten hours of training can easily perform such tasks as locating and picking up small objects like a ball of string or even an envelope lying on a table. The instru-



Figure 1. The Radarsonic Lantern.

ment can sense and discriminate very small objects, for example being able to detect and render identifiable a pencil at a distance of 2 m, making the Lantern a true and extremely efficient environmental sensor.

In summary, there are four features of the sonic torch which the blind user combines to form a mental picture of his environment:

1. The lateral discrimination inherent in scanning a narrow beam;
2. The range or distance information provided by the pitch or frequency of the beeping tone;
3. The quality or timbre of the signal showing characteristics of the reflected surface;
4. The intensity or loudness of the signal — this gives some information on the extent of the reflected surface, and will also vary when the angle of the instrument's 'direction of gaze' is altered with respect to a reflecting surface, the loudest signal being received when the Lantern is pointed in a direction perpendicular to the surface.

Technical details

Although the blind user has no need to be aware of the technical details of the Lantern's operation in order to use it

effectively, they are easily explained and illustrated.

The Lantern has an overall length of 165 mm, weighs 330g, and is housed in a moulded high-impact plastic case with carrying handle. Power is supplied by a self-contained 9 V rechargeable nickel-cadmium battery of 150 mAh capacity. Current drain during operation is nominally 24 mA, so that a fully charged battery provides six hours of operation. A small battery charger is supplied with the Lantern, which will fully charge the battery in 15 hours.

Two ultrasonic transducers (one transmitting and one receiving) are housed in the front of the unit (see Figure 1); these are electrostatic types, identical for transmit and receive. They require a dc bias voltage of 150 V, which is supplied by a six-stage diode/capacitor voltage multiplier driven from the ultrasonic transmit amplifier (see Figure 2).

The electronic components include 11 bipolar transistors, one FET and two integrated circuits. These and associated resistors, capacitors, etc. are mounted on two printed circuit boards contained within the rectangular portion of the case (see Figure 1). The battery is housed to the rear of the pc boards.

Only two controls are required: an ►

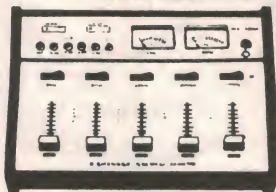
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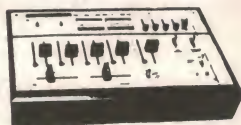
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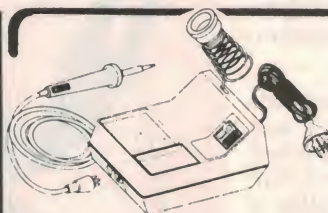
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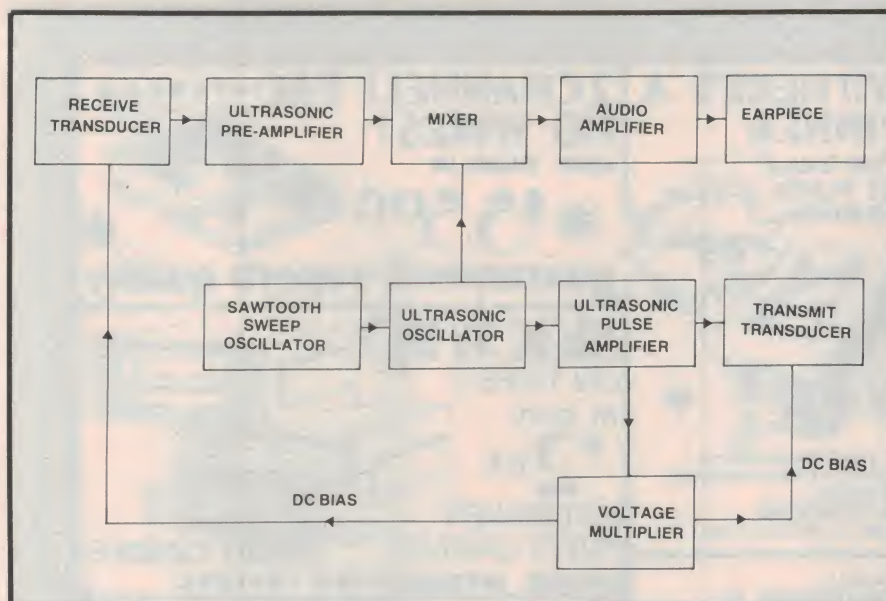


Figure 2. Block diagram of how the Radarsonic Lantern works.

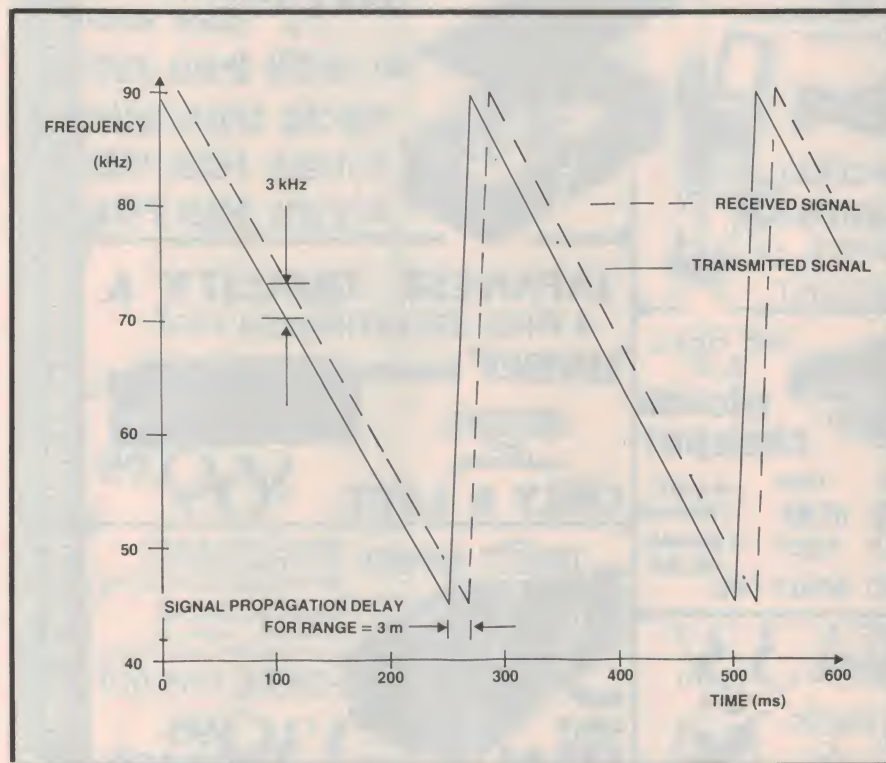


Figure 3. Transmitted and received signals.

ON/OFF switch on top of the unit and a sound volume control on the right hand side. On the left hand side of the case are the two sockets for the earpiece and the battery charger.

The unit is basically a frequency-modulated radar set, and the principle of operation may be explained easily with reference to the block diagram of Figure 2 and the graph of Figure 3.

The sweep oscillator (see Figure 2) produces a sawtooth sweep voltage having a rise-time of 250 ms and a flyback time of 20 ms. This voltage

frequency-modulates the ultrasonic oscillator, causing its frequency to sweep downwards from 90 kHz to 45 kHz and then to return, as shown by the unbroken line in Figure 3. The ultrasonic oscillator is simply a two-stage multivibrator with constant current stages supplying timing currents. These constant current stages are controlled by the output of the sweep generator.

The broken line in Figure 3 shows the frequency of the echo signal reflected from a flat, vertical object 3 m from the

Lantern. It will be seen that during the 250 ms duration of the sweep there is a frequency difference between transmitted and reflected signals of 3 kHz. The echo signal is detected by the receive transducer, amplified and fed to the mixer (which uses an MPF104 FET). Since the transmitted signal is also fed to the mixer (see Figure 2) there appears at the mixer output the difference frequency of 3 kHz. This signal, being in the audio range, is amplified by the audio amplifier and fed to the earpiece, thus producing the beeping sound characteristic of the device.

A variation in the distance of the reflecting object from the Lantern alters the time-lapse between transmission and reception, with a subsequent proportional variation in the difference (audio) frequency.

Obviously, two reflecting surfaces at different distances but both within the lateral width of the beam will produce two quite clear audio frequencies. In the buzzing confusion of the real world, surrounded by objects both stationary and moving, of various shapes and surface textures, very complex inter-modulation of the audio signals results, and the signal heard is far removed from the pure tone situation illustrated in Figure 3. However, although it would be difficult to differentiate all these signals analytically, after some experience with the Lantern the blind person learns to memorise and discriminate between the various sounds heard, and to know from the quality or timbre of the beep exactly what he is confronting.

As presently supplied the Lantern contains commercial quality components of temperature rating 0 to 70 degrees C, and the battery is expected to operate over the range 0 to 50 degrees C. The instrument might therefore fail in sub-zero temperatures. It is suitable for operation in the rain, but cannot withstand immersion. These conditions, however, are fairly common for commercial electronic products, and permit consistently reliable operation in Australian conditions as well as in the majority of conditions in most other countries. The cost of the Radarsonic Lantern in Australia, including battery charger and training lessons, is \$300.

The ultimate technological solution to the plight of the blind may be the provision of 'synthetic vision' by coupling some kind of minute television camera to electrodes implanted in the brain. Research in this area is still in a very primitive stage, however, and until such a solution is feasible, the sonic torch may well be the most practical aid yet developed to help the blind.

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
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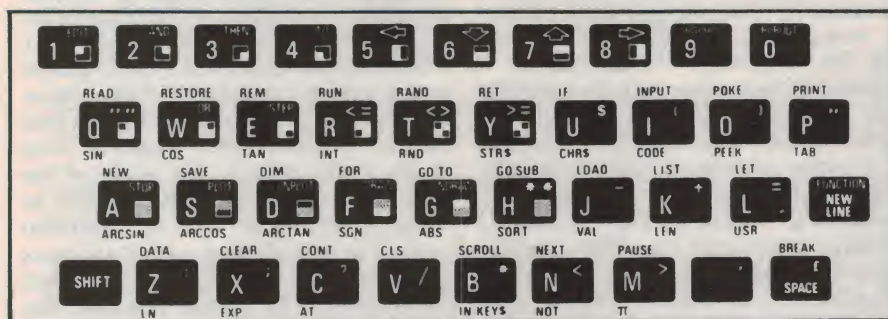
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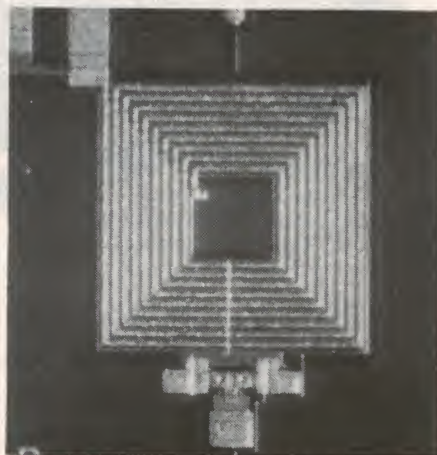
Scientists at the IBM Thomas J. Watson Research Centre have constructed experimental superconducting magnetic sensing devices whose operating characteristics approach limits imposed by fundamental laws of physics.

THE PROMISE of an increase of two orders of magnitude in sensitivity is spurring on research into new magnetic sensing devices containing Josephson junctions. The devices belong to a family called SQUIDs, Superconducting QUantum Interference Devices, which employ superconducting metals that lose all electrical resistance at temperatures close to absolute zero (273 degrees Celsius below zero).

When incorporated in complete measurement systems, the devices could permit measurement of changes in magnetic fields as small as one millionth of a millionth of the field of the earth when those changes occur at frequencies above 10 kilohertz. Such measurement capability would represent a 100-fold increase in sensitivity over existing commercial measurement systems that use similar magnetic sensing devices, for a range of application areas that includes geophysics, biomedicine, and pure science.

SQUIDs have been used in measuring variations in the magnetic field at the earth's surface, which is important in searches for geothermal energy sources and minerals and possibly in earthquake prediction. They have been used in detecting heart and brain waves (magnetocardiography and magnetoencephalography). SQUIDs have also been used to make voltage comparisons to one part in 100 million and current comparisons to one part in 10^9 . In addition, SQUIDs have played roles in attempts to detect gravity waves and in searches for quarks — fractionally charged particles believed to be the building blocks of elementary particles such as neutrons and protons. They have also been used in studies of magnetic materials. Significant improvements in SQUID performance thus have, potentially, both practical and scientific importance.

The advances discussed here were reported to the worldwide scientific community by several IBM research



This shows a 10-turn square spiral input coil coupled to a SQUID (Superconducting Quantum Interference Device). The structure just below the coil in the photo contains the Josephson tunnel junctions that are the basis for the SQUID operation. The coil is approximately 175 micrometres (0.007 inches) wide.

groups beginning early 1979 and have stimulated further work at IBM as well as elsewhere. The work relates to SQUID devices made using several different technologies.

Fabrication of the "Josephson tunnel-junction" SQUIDs relies heavily on technology developed in the long-term IBM research effort to build a laboratory prototype superconducting computer that uses related SQUID devices in experimental memory and logic circuits. Those lead-alloy tunnel-junction SQUIDs, designed and studied by researchers Dr. Mark B. Ketchen and Dr. Richard F. Voss, showed a factor-of-30 less noise than the previous best example of such a device. This performance has recently been equalled by a tunnel-junction SQUID made with a different technology based on superconducting niobium that moreover exhibits exceptional durability, according to IBM researchers Voss, Dr. Robert B. Laibowitz, Dr. Stanley I. Raider and Dr. Christina M. Knoedler, and Dr. John Clarke of the University of California, Berkeley.

Yet another SQUID technology involves IBM's recently achieved ability to construct the world's narrowest metallic stripes (as little as eight nanometers wide) with high-resolution, electron-beam lithography. The resulting ultra-small "nanobridge" SQUIDs, also fabricated out of the superconducting metal niobium, display a factor-of-two improvement over the above tunnel-junction SQUIDs when measured at a temperature of 4.2 degrees above absolute zero. This was the work of Voss, Laibowitz, and Dr. Alec N. Broers.

Technical background

The SQUIDs discussed here consist of two Josephson elements connected together in a thin-film ring of superconducting metal. Each Josephson element has two superconducting electrodes that are separated by a "weak link", either a very thin layer of insulator that is placed sandwich-like between the electrodes (to form a tunnel junction), or an ultra-small superconducting stripe connected between coplanar electrodes (to form a nanobridge). These weak links give rise to so-called Josephson coupling effects by allowing supercurrents of electron pairs to "tunnel" or pass from one electrode to the other, up to some maximum supercurrent.

SQUID operation is based on such Josephson tunnelling and magnetic-flux quantisation. In the latter phenomenon, when a superconducting ring is placed in an external magnetic field, supercurrents are set up in the ring such that the net magnetic flux (magnetic field times area) through the plane of the ring takes on values that can only be integral multiples of a fundamental unit of magnetic flux called the flux quantum. The essential point is that fields external to the SQUIDs affect the supercurrents through them: the fields change the maximum amount of supercurrent that can exist in the SQUIDs.

Currents greater than this critical supercurrent cause SQUIDS to enter the nonsuperconducting or voltage state.

In a complete measurement system, an input coil is used to extend the versatility of the SQUID for measurement of quantities such as voltage and current as well as to optimise magnetic-field measurements. Overall system performance, or sensitivity, thus depends on the input circuit as well as the SQUID. Achievement of near-ultimate low noise levels in SQUIDS consequently increases the importance of optimising the input circuit for the purpose of improving overall system measurement sensitivity.

IBM researcher Ketchen, together with Mr. Jeffrey M. Jaycox, an MIT graduate student working at IBM, most recently reported such an optimised input coupling scheme. They devised and tested a method for lithographically constructing a lead-alloy thin-film multiple-turn coil directly above a SQUID loop. The input coil is in the shape of a square planar spiral. A lead-alloy SQUID and a tightly coupled 100-turn input coil occupy an area of approximately two square millimetres.

Noise is the ultimate limit to the sensitivity of a SQUID sensing device. It can result, for example, from random motion of electrical charge produced by

the thermal agitation at elevated temperatures. But even at absolute zero, noise still exists as so-called zero-point fluctuations, a manifestation of the uncertainty principle of quantum mechanics. Indeed, the IBM researchers showed that the noise in the niobium nanobridge SQUID is only somewhat greater than the limit set by fundamental physical theory.

In agreement with circuit theory, SQUID-noise reduction was a result of decreased size of the Josephson

elements as well as optimisation of circuit parameters. The cross-sectional area of the weak links in the nanobridge SQUID (that is, the cross-sectional area of the metallic stripes) was 0.001 square micrometres. For the lead-alloy tunnel junctions, the weak-link or insulator area was 10 square micrometres. Finally, for the niobium tunnel junctions, the weak-link area was 1.0 square micrometres.

The reported low-noise behaviour has been demonstrated only when magnetic-field changes occur at relatively high frequencies (10 kHz to 100 kHz). At sufficiently low frequencies, performance of all devices is degraded by the presence of so-called $1/f$ noise. Such noise (read "one over f noise") becomes more and more pronounced as the frequencies of the magnetic-field changes decrease.

Measurements of the $1/f$ noise have been made for the lead-alloy SQUID by Ketchen and Dr. Chang C. Tsuei. This noise was found to be comparable to that in commercially available SQUIDS, indicating that the strength of the IBM SQUIDS is in their higher frequency performance. The origins of $1/f$ noise are not well understood. Continuing research on these SQUIDS could improve our understanding of the origin of that noise.

Supercooled AD converter produces 6 bits at 2 GHz rate

Researchers at the National Bureau of Standards in Boulder, Colorado, have succeeded in building an experimental Josephson analog-to-digital converter capable of two billion 6-bit samples per second — the highest conversion rate ever achieved.

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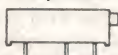
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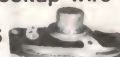


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David Tilbrook

IN DESIGNING the Series 5000 Stereo Control Preamplifier we have had to look closely at the facilities and options available on existing preamplifiers. The concept that evolved was to design a preamplifier with the accent on versatility and control. We judged that most Series 5000 components will be built by those interested in high quality sound, who will therefore spend a considerable time taping, either from source material or dubbing from one deck to another. The preamp should therefore offer good facilities for taping and tape dubbing.

Tape facilities

Two tape inputs have been provided, either of which can be selected as a source input or used through a conventional tape monitor circuit. Dubbing from one deck to another is simply a matter of selecting the playback deck as an input and selecting the record deck with the tape monitor facility. Now if a tape deck were put into record mode and then selected as a source, its output would be connected via the preamplifier back to its own record input. This forms a feedback loop that would lead to oscillation, probably within the audio spectrum and at full power. To prevent this, this preamplifier automatically mutes the record output to any tape deck that is selected as a source input. If any other source is selected the muting is removed. Thus, both decks can be used simultaneously to record source material.

Metering

Another facility that is *essential* for high quality taping is a really good set of level meters. Unfortunately, those supplied on most cassette and reel to reel decks are of the -20 to +3 VU type and as such are poor indicators of the true audio level. To overcome this problem the Series 5000 Preamp has been provided with two wide dynamic range LED level meters, each with 3 dB resolution and covering the range

-48 to +9 dB, so a dynamic range of 57 dB can be displayed. The LED level meter displays *both the peak and the average* of the audio signal at any instant, with the peak indicator having a rapid-attack/slow-decay characteristic that ensures any transient can be easily seen on the display. The prototype has been tested with single pulses and even with pulses as short as 50 μ s the transient was accurately recorded and easily spotted.

A 400 Hz sinewave oscillator is also provided and is selected by one of the positions of the tape input selector. This enables calibration of 0 dB on the LED level meters to match the 0 dB reading on the tape deck meters.

This LED level meter will also be valuable in many other projects where accurate monitoring of an audio signal is required. For this reason we have given it a separate project number (ETI-458). Full details were given in the June issue, so many constructors may already have built the LED level meter.

The preamplifier is provided with both *master* and *monitor* volume controls. The master control varies the output to the LED level meters and to the line and tape outputs. In this way the record level can be adjusted. The monitor volume control varies the signal level on the monitor output. Normally the power amplifier would be connected to this output so that the volume can be adjusted without affecting the record level. If the monitor level control is turned fully up, however, and the master control used as the main volume control, the LED level meters indicate the output level below 1.2 V, which corresponds to full power from the power amp. So, in this configuration, the LED level meters function as output level indicators, with full power before clipping occurring at 0 dB.

Mono switching

The ability to mono the two channels is another feature essential in a preamplifier. In the Series 5000 Preamp

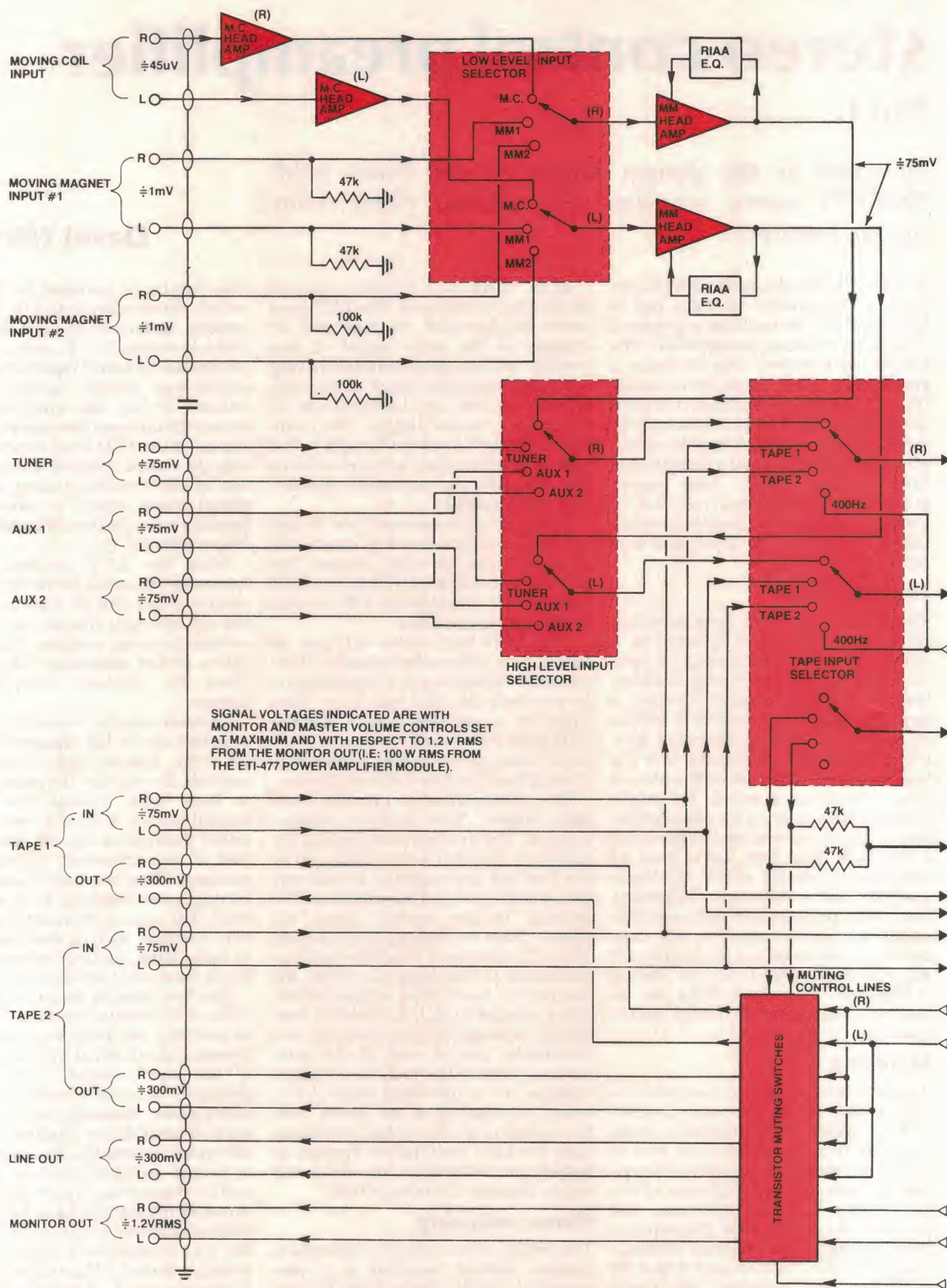
this feature is provided by the *mode* switch which offers both pre- and post-monitor mono switching. If the source mono is selected (L+R, source) the two channels are shorted together before the source-tape switch, actually at the outputs of the line amplifiers. This monos the tape and line outputs, and the inputs to the LED level meters. In this way the record levels on the tape decks can be easily matched using the source signal itself, which is virtually impossible when the two channels have a stereo signal.

Since the L+R (source) position monos the channels before the balance control it can also be used to optimise the left and right channel balance for a certain listening position. Once again, this is almost impossible to do properly when the channels have different signals.

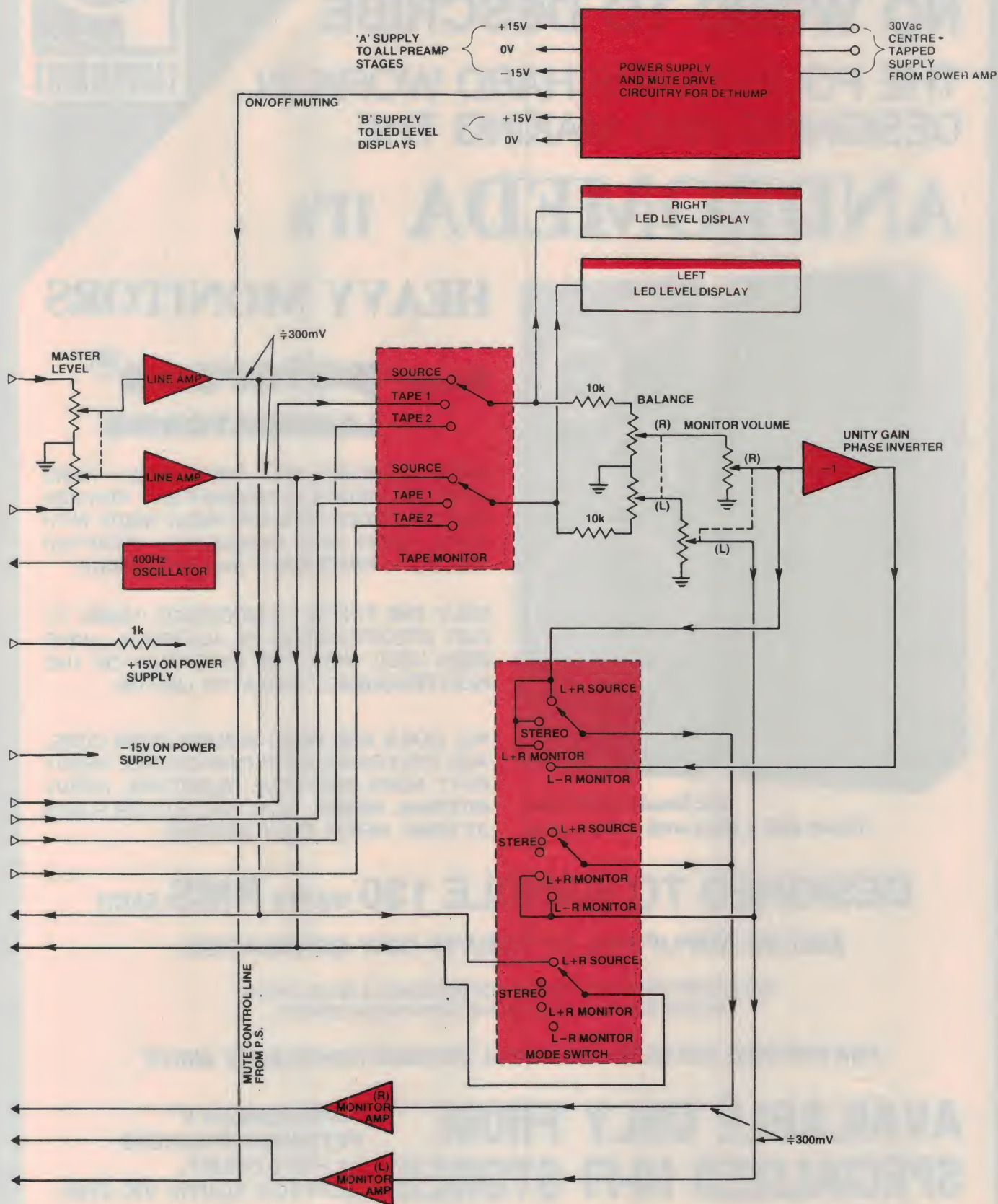
The post-monitor mono facility (L+R, monitor) shorts the channels together *after* the balance and monitor level controls. In this way the stereo content is kept valid through the balance control so that it can be used to select either the right or the left channel and feed it simultaneously to both loudspeakers. This is a particularly useful facility when listening for a suspected fault that may exist on only one of the two channels, such as cartridge faults, or more often, skating errors produced by an incorrectly set-up tone arm.

The final position on the mode switch is the L-R (monitor) position. This acts in precisely the same way as the L+R (monitor) position but inverts the phase of the right channel first. This is primarily to facilitate easy detection of out-of-phase channels such as would occur if cartridge or loudspeaker leads are wired incorrectly. The mode switch is simply switched between the L+R and L-R positions. The system is set up correctly if the sound has a full bass end and a stationary image in the centre of the two loudspeakers when the mode switch is in the L+R position. If the bass is better on the L-R position, however, ▶

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then the system has an out-of-phase channel. The surest way to perform this test is to position the loudspeakers directly facing one another and approximately 50 mm apart. The bass should drop *dramatically* when the L-R position is selected.

Block diagram

The overall configuration of the Series 5000 Stereo Control Preamp is best seen by looking at the block diagram. The preamp has both moving coil and moving magnet cartridge inputs. The moving coil phono input is fed directly to a moving coil input preamplifier which amplifies the output of the cartridge up to typical moving magnet signal voltages. The *low level input* selector switch determines which of the three cartridge inputs is sent to the RIAA-equalised phono preamp stage. The output of this stage is around 75 mV for a 1 mV input signal to one of the moving magnet inputs. The *high level input* selector switch selects between the output of the phono preamp and one of three other line level inputs (the tape input and two auxiliary inputs).

The output of the high level input selector is fed to the *tape input* selector together with the two tape inputs and the output of the inbuilt 400 Hz oscillator. A third set of contacts on the switch is used to drive the *muting* transistors whenever a tape input is selected as a source.

The output from the tape input selector switch is fed through the master level control and line amplifiers to the tape and line outputs, and to the LED level meters and tape-source switch, through the balance and monitor volume controls and via the monitor amplifiers to the main monitor output.

The signal voltages shown on the circuit are with respect to a 1.2 V signal from the monitor output and with the master and monitor level controls fully up. In this condition the average signal voltages at the input to the LED level meters will be around 300 mV. Since the preamplifier is never run with the level meters off scale it is impossible for the preamplifier to overload any stage after the line amplifiers; this is another distinct advantage offered by the LED level meters. As stated earlier, typical signal voltages at the input to the master level control are around 75 mV for a 1 mV input signal to one of the MM inputs. Most moving magnet cartridges produce maximum output signal

voltages of the order of 60 to 80 mV. Some higher output cartridges may produce signals as high as 120 to 140 mV but these are generally the exception. Allowing for a signal input voltage of, say, 140 mV, the output voltages from the main phono amplifier will be approximately 10 V RMS. So this stage must be provided with adequate supply voltage and slew rate capabilities so that overload cannot occur. Fortunately this is not particularly difficult, necessitating a supply voltage of around 15 V and a slew rate of approximately 1 V/ μ s.

A more detailed discussion of the slew rate requirements of phono stages will be included in part two of this series of articles on the Series 5000 Preamp.

Using op-amps?!

The basis of the Series 5000 Preamplifier is a new audio op-amp by Signetics, the NE5534N and its low noise complement, the NE5534AN. These devices are capable of truly *superb* performance. There is a popular misconception among audiophiles that op-amp stages cannot 'sound' as good as discrete designs. This undoubtedly has come about due to the introduction of some earlier amplifiers that used 741s, or similar devices, which are simply not suitable for audio applications. The noise performance of these earlier op-amps was mediocre and their slew rate figures were typically less than 1 V/ μ s. If we consider the output stage of a preamplifier, for example, the maximum output signal voltage from the stage is required to be around 1 V and this dictates a slew rate substantially higher than is possible from a 741 op-amp. The result is slew limiting distortion or TIM (transient intermodulation distortion).

The slew rate figures for the 5534, however, are *in excess* of 10 V/ μ s, giving the device a large-signal bandwidth of around 10 MHz and maintaining the open-loop gain at 10 kHz at greater than 6000. This is important since it ensures that the negative feedback loop of the stage will not be degraded at higher frequencies. The noise performance of the 5534 is equally good, being equal to or better than the best discrete input stages for input impedances above 1000 ohms.

In order to test the 5534, a high quality moving magnet input stage and a line amplifier stage were built with discrete transistors. Actually these stages were originally designed for the Series 5000 Preamplifier before the

5534s were available. These stages were compared with similar stages designed around the 5534s and both objective and subjective testing was carried out. Both the discrete and IC stages gave measured distortion figures less than 0.001% at all operating frequencies up to 20 kHz. The noise figures were similar and none of the stages gave any indication of slew rate limiting. The subjective testing was carried out by comparing the two phono amps and then the two line amps. The input signal was sent via a selector switch to the inputs of the two stages and the levels matched by potentiometers at the outputs. The wipers of the pots were then connected to a second set of contacts on the selector switch. This configuration allows both the input and the output of the unused stage to be disconnected from the circuit so that no possibility of interaction exists.

After many hours of experimenting with this circuit we were *still unable to determine which stage was operating at any one time*. The op-amp circuit, however, contains approximately half the number of components of the discrete design.

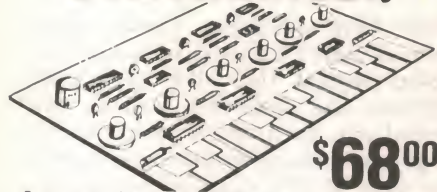
A complete data sheet for the NE5534N will be included with part two of this series.

Tone controls?

As stated earlier, the Series 5000 Preamplifier is intended as a high quality linear preamp, and as such, the conventional tone control circuits have been omitted. This is becoming the accepted practice on high quality preamplifiers, since the usual tone control facilities are very seldom used in good sound systems. More importantly, their presence can impair the sound quality unless provision is available to completely remove them from the circuit. If control over the frequency response of the system is required it is usually to overcome problems associated with room acoustics, and conventional tone controls are practically useless. A 1/3-octave graphic equaliser is much more effective and can be incorporated into the system easily. The equaliser is placed in the monitor output circuit, between the output and the power amplifier input, leaving the line output of the preamp free as a general purpose non-equalised output.

In following articles we will describe the specifications and construction of the Series 5000 Preamp as well as the problems that must be overcome to ensure the best possible performance.●

'ELECTROTUNE' SYNTHESIZER



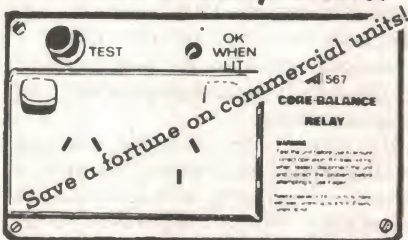
\$68⁰⁰

A mini synthesizer with 23 note touch keyboard. Has attack & delay, voicing controls. Easy to set up, no fancy test equipment required. It's incredible, the range of sounds it will produce will amaze you.

Cat. K-3506 SEE EA JULY

CORE BALANCE RELAY

earth leakage electronic circuit protector



Includes pre-wound coil

This one should be in every hobbyists workshop - it could save your life! Senses any leakage to earth from a mains appliance (e.g. through your body) and shuts off power before it has a chance to electrocute you.

SEE ETI APRIL

\$49⁵⁰

Cat. K-3315

TV UHF Downconverter

\$32⁵⁰

UHF TV is here: but only a small percentage of TV's are fitted with UHF tuners. Use any standard VHF TV set with this converter: use for a single channel

Cat. K-3235

SEE ETI MAY

INFRA RED BEAM RELAY



Cat. K-3375

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Ideal burglar alarm, door minder, etc. Sounds alarm if beam is cut. Also fantastic for wildlife photography.

SEE EA
APRIL

DICK SMITH ELECTRONICS

LOOK AT THESE



CAR ALARM

\$27⁵⁰

The design senses current in the battery earth lead. Reliable circuit, has delay exit features built in. Versatile, will operate with most cars. Easy to install.

Cat. K-3253 SEE ETI JULY

BENCHMATE



Just the thing for the hobbyist's and experimenters bench. A handy kit featuring a 1.25V. to 16V. @ 1A. power supply, a 1 watt amplifier with HI & LO inputs. Comes with a sturdy metal case, easy to build.

K-3478 SEE EA JUNE

\$45

Requires external speaker, you can use the Dick Smith Cat. A-2451 \$9.50

Improve your health NEGATIVE ION GENERATOR



With exclusive Dick Smith easy to build emitter head.

Completely safe - battery or plug-pack operated. With an incredibly well researched article showing how beneficial negative ions can be!

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SEE ETI APRIL

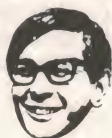
dB METER

Troubled by noise? Worried about exceeding noise pollution laws? Build this simple dB meter and find out. Easy to build, save \$\$\$ on commercial units.

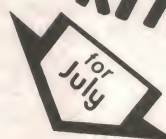
Easy to build.

Cat. K-3476
SEE EA MAY

\$34⁵⁰



GREAT NEW KITS



LOTTO-POOLS SELECTOR



Random number generator picks your squares, don't blame mum. This box of tricks doesn't favour any number. It's simple to build, think of those \$\$\$

Cat. K-3392 SEE EA JULY

AUDIO OSCILLATOR

Ideal for audio HI-FI design, test, and repair.

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Sine wave, typically .003%

Square wave, 20nS rise and fall times.

15kHz to 150kHz with overlapping ranges.

VMOS output stage, 3mV to 3V in 3dB steps.

Cat. K-3467 SEE EA JUNE

\$65⁰⁰



INFRA RED REMOTE CONTROL

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Cat. K-3380
SEE EA MAY

\$63⁹⁵

HOT CANARY (short form)

SEE EA MAY

A gimmick that will keep any child amused for hours! An electronic bird whistle that sounds just like the real thing.

Cat. K-3395

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SERIAL INTERFACE (For System 80)

Enables your System 80 or TRS-80 computer be used with many of the serial-type devices: teleprinters, etc. A must for the hobbyist buff gives you the chance to use ex-disposals gear.

Cat. K-3608
SEE EA APRIL

\$57⁵⁰

SPEED SENTRY (short form)

SEE EA MAY

For safer driving. An alarm sounds if you go over a preset speed. You set the speed.

Cat. K-3245

\$11⁷⁵

See our other advertisements in this publication for addresses, phone numbers, post and packing etc.

'Current trip' car alarm features exit/entry delay and no false alarms

This car alarm uses the battery earth strap as a sensor to detect when a 'courtesy' light or other electrical load occurs when a thief enters a vehicle. The circuitry is simple and immune from false triggering problems.

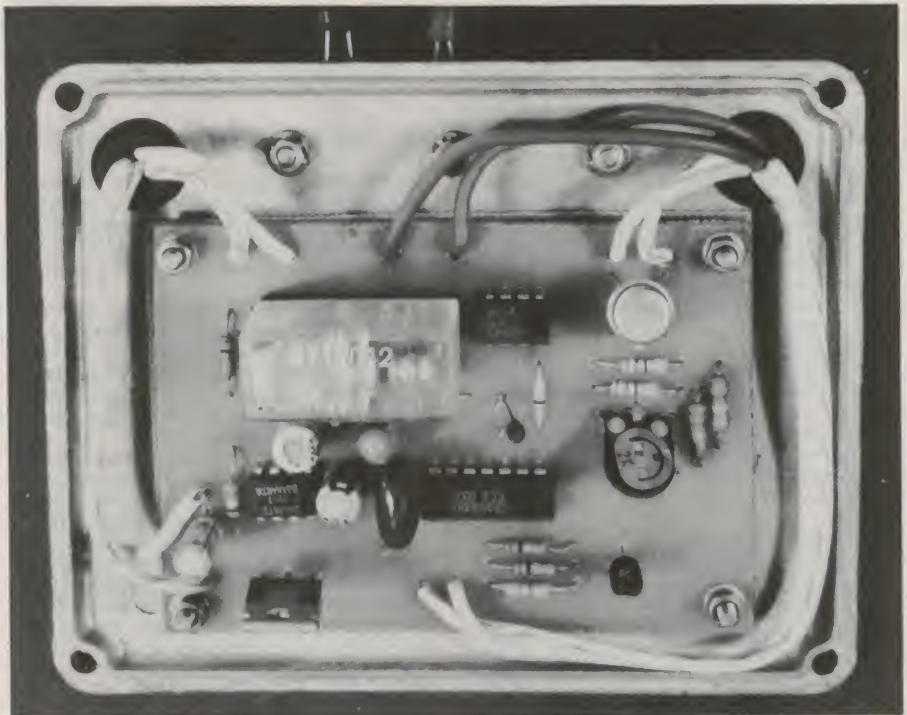
Phil Wait

A SIGNIFICANT proportion of cars are stolen at least once in their lifetime. The thieves are generally 'joyriders' who use them for a few hours and then abandon them after vandalising such items as wheels, seats, stereo/radios etc. If you fit a good, reliable alarm you're bound to deter all but the most determined of criminals — who are usually professionals out to 'redo' the car or strip it completely for parts. There's almost nothing that will stop the latter type of thief — alarms, steering locks or any other deterrents notwithstanding.

Early car alarms were electro-mechanical by nature. They generally had a balanced cantilever or a pendulum with a switch contact attached. Any movement of the vehicle would close the contact and latch on a relay sounding the horn. Simple and effective — but prone to false triggering. They've all but disappeared. Others operated from a series of hood and door switches, but installation often proved a major undertaking.

Later alarms became more sophisticated — one type sensed the slight voltage-drop pulse that appears across the vehicle battery's terminals when a load is connected — such as a 'courtesy' light being operated when a door is opened. Reliability often proved a problem with these alarms as they depended on the internal resistance of the battery, which causes the voltage-drop pulse following the connection of a load (the battery terminal voltage drops momentarily and then rises again). Any variation in the terminal clamp resistance produces the same effect — giving rise to false triggering problems.

A cunning variation on this is to detect a voltage drop anywhere in the vehicle's electrical system. We pub-



The completed unit was mounted on the lid of a diecast box with a scrap of blank pc substrate underneath as an insulating spacer. The external leads are passed through two grommets holes.

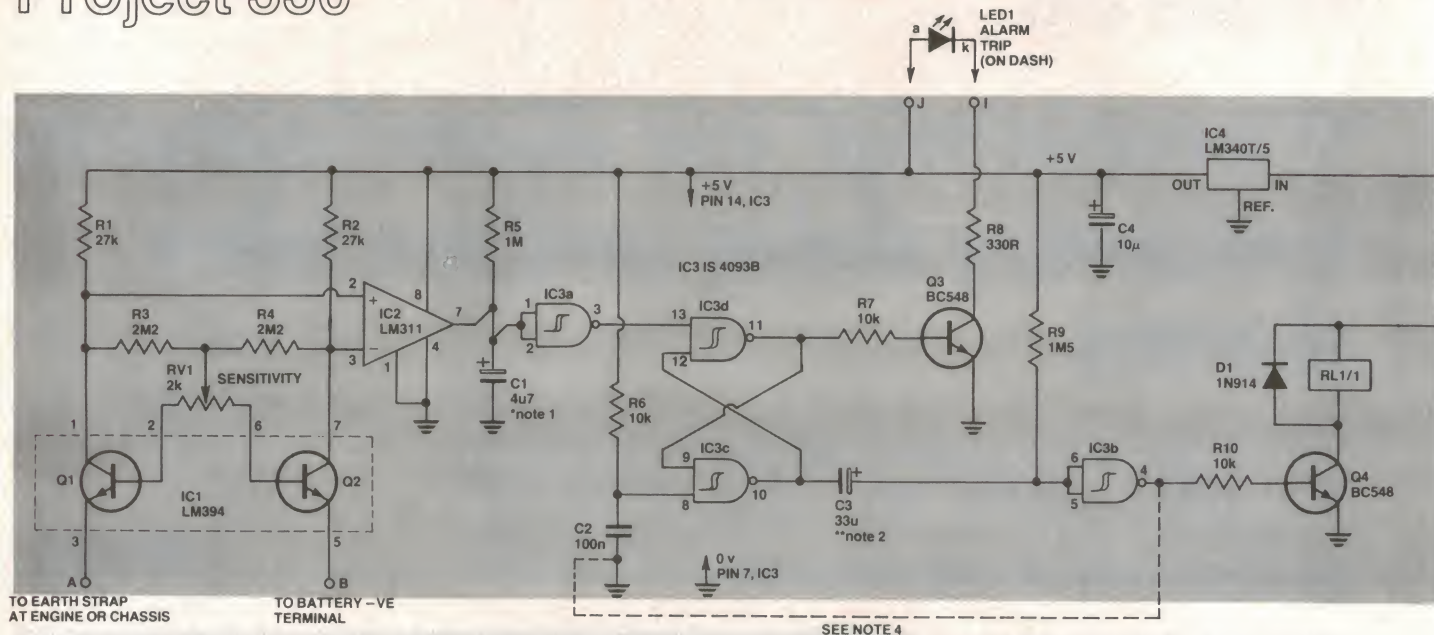
lished the design for such an alarm some time back in our book 'Project Electronics' (ETI-084). Whilst a popular project, many constructors reported problems with false triggering. In addition, the alarm did not include entry and exit delay times, which many constructors have requested over the years.

This project employs a similar principle to the ETI-084, but rather a different technique. The battery 'earth' strap has a small, but finite, resistance. Any load on the battery will cause a current to flow through the earth strap

(since the vehicle's chassis is used as the return circuit). The current causes a small voltage drop across the earth strap resistance. This is detected and used to trip the alarm. As the 'sensing' input is essentially a very low impedance input, false triggering from magnetic induction or other sources is avoided. Other voltage drop sensing schemes essentially have a medium to high input impedance, hence their susceptibility to false triggering.

Additional measures are incorporated in this project to further reduce the possibilities for false triggering. ►

Project 330



*NOTE 1: Value of C1 sets entry and exit delay times.

**NOTE 2: Value of C3 sets alarm-on time.

***NOTE 3: Value of C5 sets flash and horn pulse rate.

NOTE 4: If you wish the alarm to reset itself after 45 seconds following tripping, lift the 'earthy' end of C2 and connect it to pin 4 of IC3b as shown by the dotted line.

NOTE 5: Capacitors C1, C3 and C5 may be either tantalum types or so-called 'low leakage' electrolytics such as the Eina RBLL, or similar.

HOW IT WORKS — ETI 330

Any load on the electrical circuit of a vehicle will produce a voltage drop across the small, but finite, resistance of the vehicle battery's 'earth' strap. This unit detects that voltage drop and trips an alarm circuit that operates the vehicle's horn. A thief entering the vehicle will inevitably operate a 'courtesy' light or something that draws current, thus tripping the alarm.

The circuit can be divided into five sections: the sense circuit, entry and exit delay circuit, latch circuit, alarm timing circuit and horn pulsing circuit. In addition, a three-terminal regulator provides a 5 V supply to most of the electronics, avoiding problems with false alarms.

THE SENSE CIRCUIT

The current in the earth strap is sensed by a pair of transistors connected in a common base configuration. These two transistors, Q1 and Q2, are encapsulated in an integrated circuit package and are on a single chip of silicon, ensuring that they have very closely matched characteristics. The device is known as an LM394. This device was used in much the same way in our Expanded Scale Vehicle Ammeter, ETI-329, published in the February '81 issue. The base-emitter voltages of each transistor will track within 50 microvolts of each other, a characteristic which is exploited here.

When no current is being drawn from the battery there will be no potential drop across the resistance of the battery earth strap (ignoring the miniscule current drawn by this alarm). Thus, the emitters of each transistor in IC1 will be at the same potential. As the base-emitter voltage of each is virtually identical the collector currents will be identical. Thus initially, the collector-emitter voltage of each will be the same.

When current is drawn from the battery (when a courtesy lamp is operated, for example), a small voltage drop will appear across the battery earth strap. Thus, point A

(emitter of Q1) will be raised to a *higher* potential than point B (emitter of Q2). That is, point A will be more positive than point B. The voltage on the collector of Q1 will thus rise (a common base amplifier is a *non-inverting* amplifier).

The voltage difference between the collectors of Q1 and Q2 is monitored by a differential input comparator, IC2 — an LM311. When the voltage on its non-inverting input exceeds the voltage on its inverting input the comparator's output switches high. What happens next we'll get to shortly.

The voltage on the collector of each transistor in IC1 (Q1 and Q2) is initially set by a trimpot, which varies the current fed to each base. This compensates for any slight mismatch between Q1 and Q2 (the dc gain of this circuit is very high) and also acts as a 'sensitivity threshold' control by introducing a preset offset which must be overcome by a certain level of current through the battery earth strap before the alarm will trigger.

ENTRY AND EXIT DELAY

The comparator IC2 has an open collector output requiring an external load resistor — this is R5. When the output of IC2 is low the timing capacitor, C1, is held discharged by IC2's output circuitry. When the alarm is tripped and the output of IC2 goes high C1 starts to charge through R5. After a time determined by the time constant of R5 and C1 the Schmitt gate IC3a toggles over and its output, pin 3, goes low.

LATCH

The Schmitt gates IC3c and IC3d form a latch circuit. On power up, the latch is automatically reset by the time constant of R6 and C2, placing a momentary low on pin 8. The output of IC3c is high and the output of IC3d is low, Q3 is turned off and LED1 is not lit.

When the output of IC3a goes low the latch (IC3d and c) toggles over. The output of IC3d goes high, turning on Q3 and lighting LED1. The output of IC3c goes low at the same time.

The latch remains in this state until it is reset when the power is turned off and then on again.

ALARM TIME PERIOD

Before the alarm is triggered the output of IC3c is high and the input of IC3b is held high by R9. As IC3b is wired as an inverter its output is low and Q4 is turned off. When the alarm is triggered the output of IC3c goes low, and since C3 is discharged, the input of IC3b is pulled low, its output goes high and Q4 is switched on, allowing the relay to operate.

The timing capacitor, C3, slowly charges through R9 and, after a period determined by the time constant of C3/R9, IC3b switches over, turning Q4 off again and stopping the horn.

HORN PULSING CIRCUIT

The relay RL1, and therefore the horn, is pulsed on and off about once per second during the horn timing period. IC5 is a 555 timer wired as a free-running oscillator. The frequency of oscillation is determined by the time constant of R12 and C5. As the 555 is capable of driving quite high currents it is connected directly to the relay, which is then switched by Q4. In other words, the 555 pulses the supply to the relay.

The output from the 555 is also used to pulse LED2 (mounted on the dash) as a warning to would-be car thieves and as an indication that the alarm is on.

REGULATOR

A three-terminal regulator, IC4, drops the battery voltage down to 5 V to supply the sense and timing circuits. This protects against false triggering from battery voltage variations and also helps to remove noise from the supply.

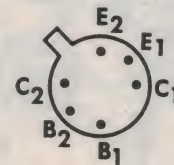
Using a Schmitt-triggered input quad NAND gate for IC3 provides further noise immunity and reliable timing due to the precise switching action of its inputs.

THE LM394 FAMILY AND ALTERNATIVES

There are a number of devices in this monolithic npn dual transistor 'family', each characterised by different tolerance specifications. The LM194 is the mil-spec version which has the tightest specifications and top price. It's also hard to get and its use is not really necessary in this application. The LM394 is available in 'H' and 'C' versions. The LM394H has tighter tolerance specifications than the LM394C and is more expensive. The cheaper LM394C is recommended for use in this project as it is the least expensive member of the family and generally obtainable in good quantities.

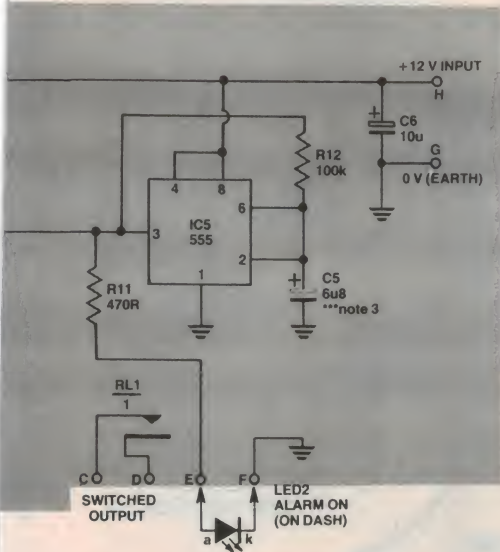
Philips manufacture an npn dual transistor family, designated BCY87, BCY88, BCY89, and any of these could be pressed into service in this project, although their V_{be} tolerance specifications are somewhat wider than for the LM394 family. There should be sufficient adjustment available with RV1 to compensate for the wider tolerance in V_{be} offset. The BCY89 is the least expensive, widest tolerance device. Note that the package pinout for the Philips devices is different — see the diagram following.

A further alternative would be to use two transistors from a transistor array IC. The CA3045/46, manufactured by RCA, is a general purpose transistor array IC containing three isolated transistors and one differentially-connected transistor pair. Any two of the isolated transistors may be used. However, this device is encapsulated in a 14-pin DIL package which would have to be glued to the pc board in a suitable place, upside down, and connecting wires run from the appropriate holes in the pc board to the device pins. RV1 should be able to compensate for the wider tolerance in V_{be} offset here too.



BOTTOM VIEW

BCY87/88/89
FAMILY PINOUT



Design

A block diagram of the alarm is shown in Figure 1. The Sense and Trigger circuit detects when the voltage drop across the battery earth strap rises above a predetermined amount. When triggered, this then arms the entry/exit delay. If the alarm does not remain triggered after the delay period nothing further will happen. If it does remain triggered, the delay circuit will trip the Latch and start the Alarm Period Timer. The Alarm Trip Indicator will also light. When the Alarm Period Timer is activated the Relay Driver is also activated. The Relay Driver will then turn the relay on and off at one-second intervals, pulsing the horn on and off too.

The Relay Pulser circuit operates continuously and flashes a dash-mounted light to indicate that the alarm unit is 'armed'.

After the Alarm Period Timer completes its period, the Relay Driver is turned off and the horn will cease pulsing on and off at one-second intervals. Car alarms are required by law to turn off within ten minutes of being triggered, but can automatically re-arm.

If someone attempts to steal your car, trips the alarm and then abandons the attempt, the Alarm Trip Indicator will remain on, telling you that the alarm was tripped during your absence.

Construction

Our prototype was constructed on a printed circuit board, the artwork for which is reproduced elsewhere in this article. While this is not absolutely necessary — the project could be con-

structed on matrix board — a pc board does reduce the possibility of wiring errors, which have to be sorted out when you first power up the project.

There is no particular order for assembling the components to the pc board but it is usually easier to solder the resistors and capacitors in place first. Take care with the orientation of the tantalum and electrolytic capacitors. Follow with the semiconductors. Again, watch orientation of these components. The relay should be mounted last of all.

The completed pc board can be

mounted in any convenient case — we housed ours in a diecast box measuring 120 x 40 x 95 mm. A diecast box was chosen because it can be effectively sealed against the ingress of dirt, moisture and other undesirable substances.

We mounted the pc board on the underside of the diecast box's lid and fitted a 10-way terminal block on the outside of the lid for all the external connections. Leads from the pc board to the 10-way terminal block are passed through grommetted holes. These were later sealed with Silastic.

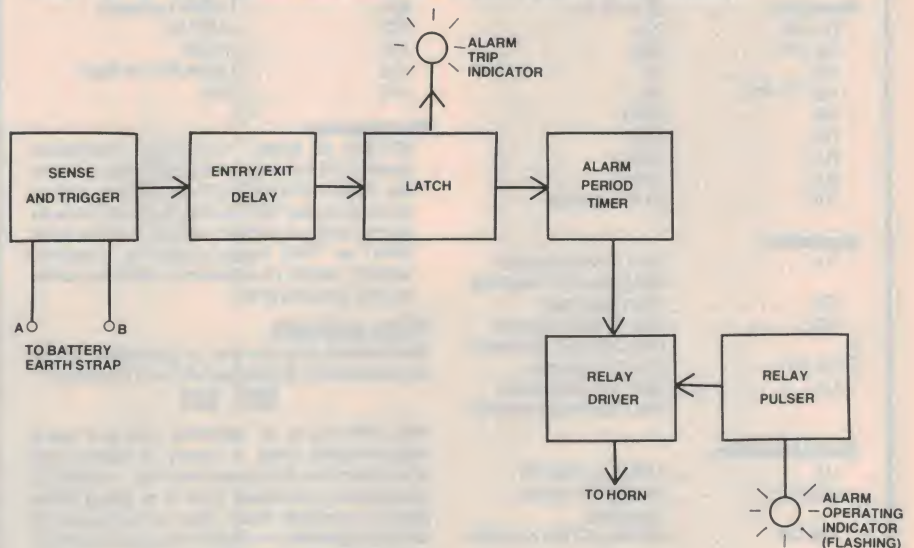
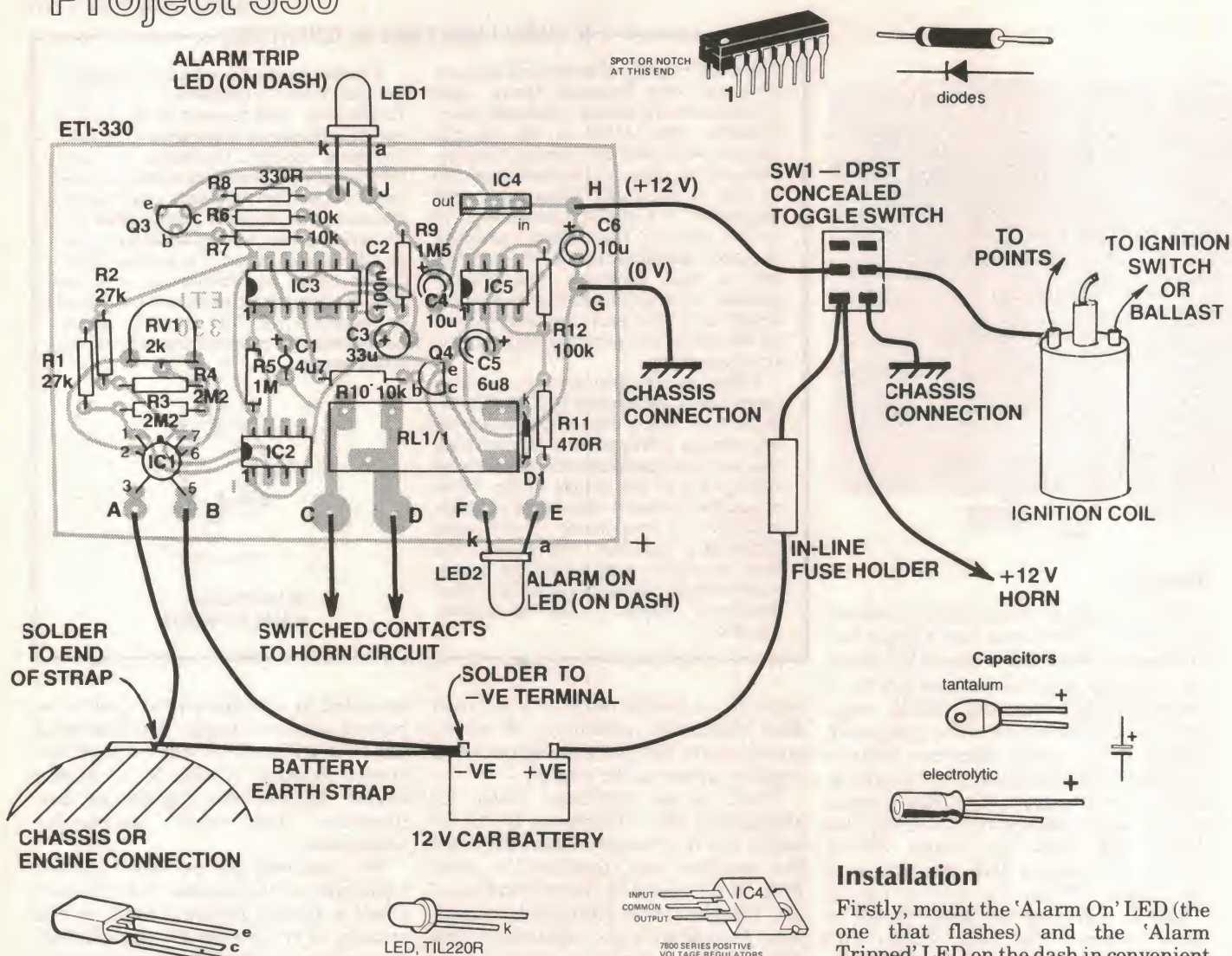


Figure 1. Block diagram of the ETI-330 car alarm showing the basic functional blocks of the circuit.

Project 330



PARTS LIST — ETI 330

Resistors

all ½ W, 5%
 R1, R2 27k
 R3, R4 2M2
 R5 1M
 R6, R7, R10 10k
 R8 330R
 R9 1M5
 R11 470R
 R12 100k
 RV1 2k min. trimpot

Capacitors

C1 4u7/16 V tantalum or RBLL electro. (See text)
 C2 100n greencap
 C3 33u/16 V tantalum or RBLL electro. (See text)
 C4, C6 10u/16 V electro.
 C5 6u8/16 V tantalum or RBLL electro. (See text)

Semiconductors

D1 1N914 or 1N4148
 LED1, 2 TIL220R or similar (see text).
 Q3, Q4 BC548, BC108 or similar

IC1 LM394 (see text)
 IC2 LM311N
 IC3 4093B
 IC4 LM340T/5 or 7805
 IC5 555

Miscellaneous

ETI-330 pc board; 12 V single changeover contact (10 A rating) pc mounting relay (such as the Fujitsu FRL611DO12 or similar); diecast aluminium box 120 mm long by 95 mm wide by 40 mm deep or similar; 10-way terminal strip; DPST or TPST toggle switch (for concealed switch); length of automotive electrical cable; sundry nuts and bolts.

Price estimate

We estimate that the cost of purchasing all the components for this project will be in the range:

\$25 - \$32

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project such as — quality of components purchased, type of pc board (fibre-glass or phenolic base), type of front panel (if used) supplied etc — whether bought as separate components or made up as a kit.

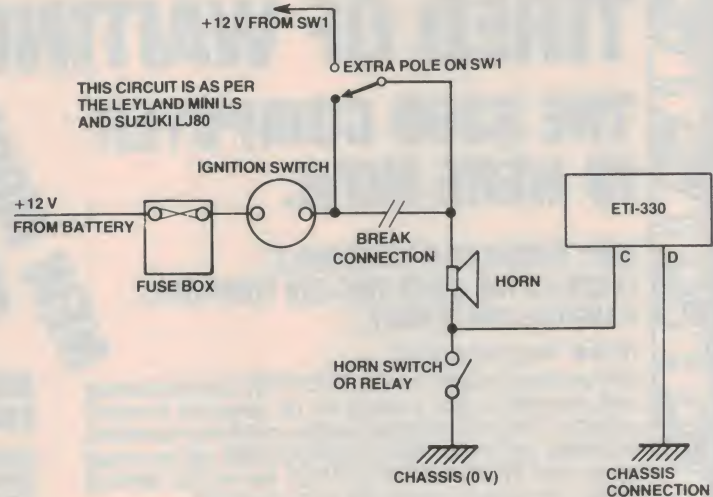
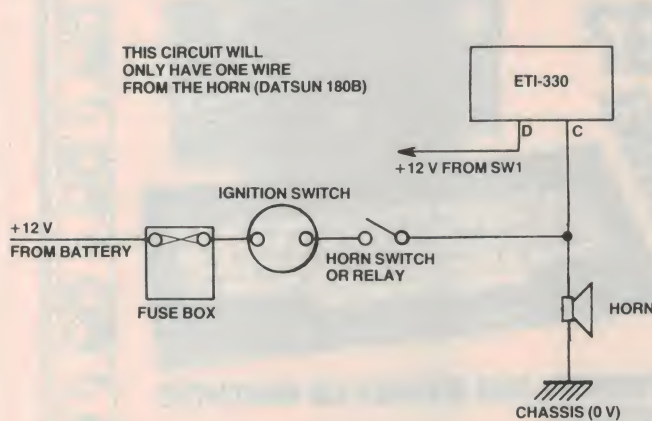
Installation

Firstly, mount the 'Alarm On' LED (the one that flashes) and the 'Alarm Tripped' LED on the dash in convenient positions where they can be seen from outside the vehicle. You can obtain LEDs mounted in metal and plastic mounting which is secured by a nut or clip, and these are ideal for this application.

The alarm is switched on by a concealed switch which may be located under the dash or under the driver's seat. Alternatively, an externally mounted keyswitch may be used. If you install the latter, entry and exit delay may be reduced to about half a second by changing the value of C1 to 1u.

We used a two-pole switch, one pole to switch the supply to the alarm, the other to short out the points when the alarm is switched on. Thus, if somebody does gain entry to the car and ignores the alarm or disconnects the horn, they will not be able to start the car even if they jumper the ignition!

Connection to the earth strap is quite straightforward. Take a wire from terminal A and solder it to the end of the earth strap. Terminal B is taken and



COMMON HORN CIRCUITS

soldered to the battery terminal connection. It's a good idea to keep these leads fairly short to reduce noise pick-up. Ours were about one metre long.

The positive supply, via the alarm switch, should be taken through an inline fuse holder, directly from the battery positive terminal. The normal fuse holder in a car is usually under the dash and could easily be pulled out by a thief when the alarm goes off.

The output from the alarm is a pair of switched contacts, which operate the horn by bypassing the horn switch or, on some cars, the horn relay. We have shown two common horn circuits. The first circuit the horn switch is bypassed by the relay contacts. The second circuit is a little more complex and requires an extra pole on the alarm

switch. If you want to short out the points as well you will need a three-pole double-throw switch. Make sure you break the connection from the ignition switch to the horn as shown, or when you switch the alarm on you will also switch on the ignition!

Try to make all wiring as neat as possible and try to blend it in with the car's wiring so it is not obvious to a thief what wire he has to pull out to stop the alarm.

Setting up

When all the wiring is complete, all that remains is to set the sensitivity trimpot. Disable the entry and exit delay by removing C1, or alternatively connect a high impedance voltmeter across C1. With no current being drawn from the

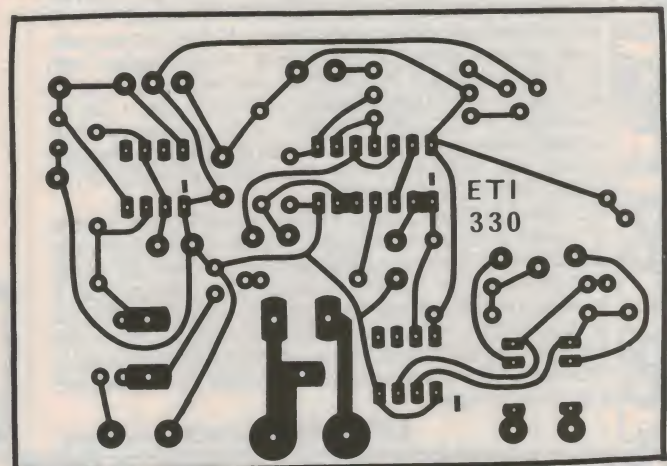
battery, adjust RV1 until the alarm just fails to trip or C1 fails to start to charge. Note the position on the trimpot. Turn on the interior light and the alarm should trip. If it does not, check your first adjustment; if it is correct, you probably have the leads to the earth strap and the battery negative terminal swapped.

Turn the trimpot until the alarm just won't trip or C1 doesn't charge when the interior light is turned on. Note this position. The correct position for RV1 is midway between these limits, for reliable operation.

Next check that the alarm doesn't trip on the car radio or the electric clock. Some mechanical clocks are rewound by a motor every few hours, or even days, and these are often a cause of false triggering. If false triggering occurs from the radio or the clock, reduce the sensitivity. In some extreme cases it may be necessary to use a higher wattage interior light, though I found operation to be extremely reliable with a five watt light, and there was sensitivity to spare!



Everything is mounted on the lid of the diecast box and terminations made via a 10-way terminal block mounted on the outside of the lid. Mark each lead, especially polarity where necessary.



TIRED OF WAITING?

THE \$399 COMPUTER IS HERE NOW.

**\$399 EXPANDABLE, AFFORDABLE...
LEARN AS YOU BUILD S100-Z80 COMPUTER...
A LOGICAL INVESTMENT...**

The New "Super Instructor 80"

Build your own computer! The INSTRUCTOR 80 is an ideal starting point designed to save a bundle for the newcomer to microprocessors. This proven design is available in kit form or assembled and tested and includes FULL INSTRUCTIONS and our unique step-by-step PROGRAMMING COURSE and our full technical backup and warranty service. We won't let you fail!

Best of all the INSTRUCTOR 80 is part of the MICROWORLD family of compatible modules all designed to conform to the S100 bus. This ensures you can expand your computer to virtually any configuration you may require! Watch out for cheap "throw-away" non-expandable imitations, the INSTRUCTOR 80 is based on the proven DGZ80 (ETI Nov. 1979) and has a large SOFTWARE base AVAILABLE NOW. You can add the required memory and run MICROWORLD 12K LEVEL II BASIC, EDITOR/ASSEMBLER, play games such as CHESS, SPACE INVADERS, TARGET and many more. More than that DGZ80 is also a useful microprocessor controller and you can experiment with ROBOTICS, SPEECH SYNTHESIS and MACHINE CONTROL. When expanded to include disk drives, your DGZ80 based computer will become a full business system capable of running world class software such as CP/M 2.2, WORDSTAR, and a host of powerful financial/inventory control packages.

The INSTRUCTOR 80 package includes the DGZ80 single board CPU, MW640 VDU, RCA keyboard complete with case, 4-slot motherboard, all necessary sockets and cables and, of course, full construction manuals and PROGRAMMING COURSE. Add a cassette interface such as the USCII and more memory such as the AT16K and you have what we consider to be the most cost effective and versatile 16K home computer available in Australia today. To operate your INSTRUCTOR 80 you need only connect a simple 8V power supply and connect to a video modulator or a video monitor such as the NT50.

The INSTRUCTOR 80 sets new standards for price and performance in a kit computer. The central processor is the powerful Z80 microprocessor, backed by a wealth of software worldwide. Full S100 expandability is a big feature of the INSTRUCTOR 80. Because we use the S100 bus from the word "GO" there is no need to purchase any \$500 type expansion interface. Load and save programs using a reliable cassette interface such as the USCII and you can even connect a printer to the powerful PIO port. The VDU generates the full ASCII character set (UPPER and LOWER case with descenders!) and 64 characters/line 16 lines to the screen. Under software control you can generate "chunky graphics" with 128 x 64 bit resolution. Optional S100 modules enable you to use such options as PROGRAMMABLE GRAPHICS (512 x 256 bit resolution), SPEECH SYNTHESISERS, additional memory to 64K including RAM and EPROM boards. You can add disk drives and convert your INSTRUCTOR 80 into a WORDPROCESSOR or SMALL BUSINESS COMPUTER.

INSTRUCTOR 80 is TOTALLY UPWARD COMPATIBLE. You can go on adding modules to build your computer to suit virtually any application. You learn as you build your own INSTRUCTOR 80 and then once you have mastered the world of the microcomputer it becomes a sound basis for future expansion. The INSTRUCTOR 80 is your LOGICAL INVESTMENT that will introduce you to the FASCINATING and REWARDING world of the MICROPROCESSOR. INSTRUCTOR 80 in kit form complete with all manuals and programming course:

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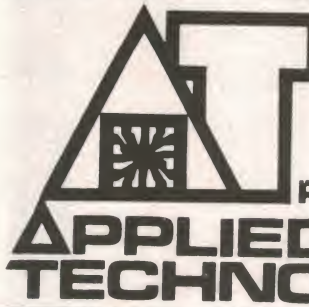
SOFTWARE: (DGOS Format on cassette)

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WIN A TELETEXT ADAPTOR!

You can access an 'electronic newspaper' on your own TV set with a Teletext adaptor. Teletext information is digitally encoded and transmitted on TV stations' 'spare' lines between each picture frame. The sort of information currently transmitted via Teletext includes: weather information, the latest news, traffic details, TAB results, share prices, currency rates, food prices, theatre and travel information, plus games, jokes and puzzles.

HERE'S YOUR CHANCE TO WIN a Teletext adaptor which will enable you to enjoy all the advantages of being able to access the huge variety of information and data available on the Teletext 'electronic newspaper'.

Radofin Electronics (Aust.) has generously offered one of their Adam 180 Teletext Adaptors as a prize for this contest, which is jointly sponsored by ETI and Radofin Electronics.

The Adam 180 Teletext Adaptor by Radofin Electronics normally retails for \$575 — here's your chance to obtain one free!

FEATURES OF THE RADOFIN 'ADAM 180'

- Simple attachment into antenna lead of TV set
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- AFC incorporated to lock in signal
- VHF and UHF inputs included
- Clock that permits you to turn on Teletext at preset time
- 12 months' warranty



DISPLAY CAPABILITIES

- Teletext or normal TV at touch of a button
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- Double height button (aids people with poor vision)
- Reveal button — shows answers to questions, quizzes
- Subtitle capability
- Newsflash capability

RULES

Entries should be addressed to ETI/RADOFIN Teletext Adaptor Contest, Electronics Today International, 15 Boundary St, Rushcutters Bay NSW 2011.

The contest will be judged by the Editor and Managing Editor of ETI whose decision will be final. No correspondence can be entered into regarding their decision.

The winner will be advised by telegram the same day the result is declared. The name of the winner, together with the winning answers, will be published in the next possible issue of ETJ.

Entrants must sign the declaration accompanying this contest that they have read the above rules and agree to abide by their conditions.

● You may enter as many times as you wish but you must use a separate entry form for each entry and include the month and page number cut from the bottom right hand page of the contest. You must put your name and address where indicated on each entry form.

ENTRY FORM

If you can't find out the right answers to the first five questions then just have a guess — you may well be right!

yes ☐

no ☐

yes ☐

no ☐

March ☐
April ☐
May ☐
June ☐

11 November 1979 ☐
18 January 1980 ☐
4 February 1980 ☐
27 July 1980 ☐

November 1975	<input type="checkbox"/>
March 1977	<input type="checkbox"/>
June 1979	<input type="checkbox"/>
February 1980	<input type="checkbox"/>

[illegible]

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Take it easy



If you like electronics but you sometimes find you're a bit out of your depth in ETI, we've got good news for you. There's a new electronics magazine called **Hobby Electronics** that makes things a lot easier.

Hobby Electronics is specially designed for easy reading. That doesn't mean we use extra big print and treat you like an imbecile — it just means that we explain everything you might not already know.

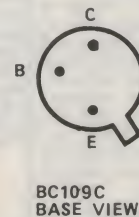
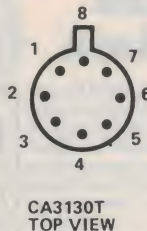
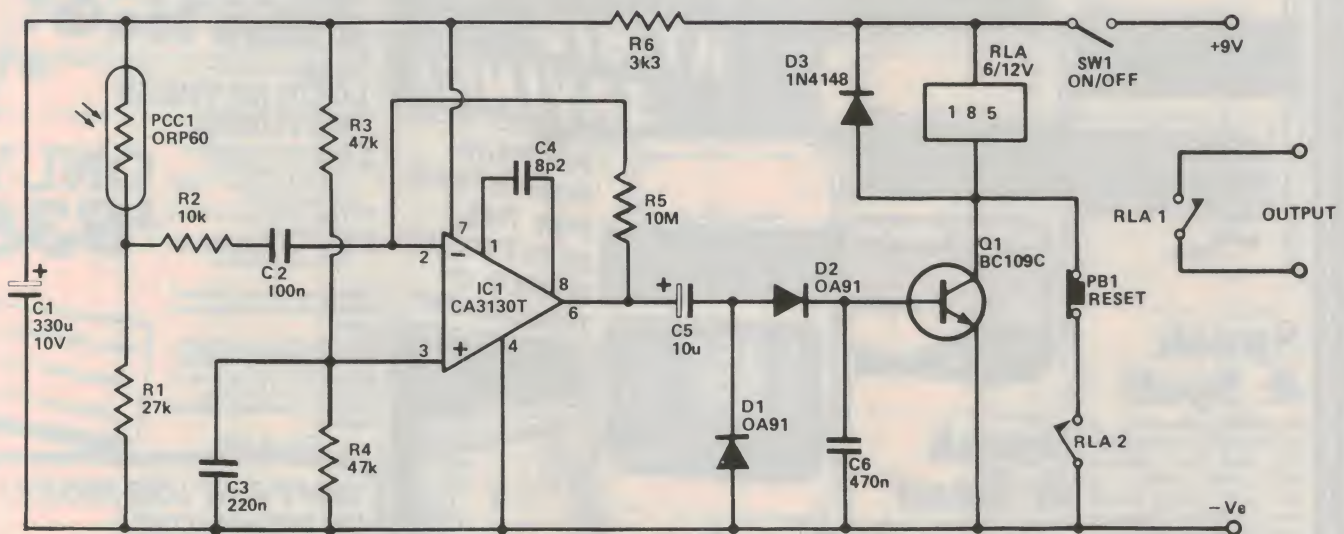
Every month **Hobby Electronics** has complete, detailed instructions for building several projects, as well as fascinating features on all aspects of electronics. And because it's published by the same people as ETI, you can be sure that everything has been done properly — all the projects have been tried and tested, all the features double and triple-checked for accuracy and authenticity.

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Hobby Electronics

AN ETI PUBLICATION

'Photocell' switch is activated by change in light level



THIS SIMPLE light-activated switch can be employed in intruder alarm systems, or in certain other applications where a proximity detector is required. It is not a light-operated switch of the type which responds to some particular ambient light level, but instead it responds to rapid changes in light level. It will, for example, trigger if a torch is shone on or near the photocell, or if someone passing in front of the unit casts a shadow onto the photocell. The unit is unaffected by natural, slow changes in light level.

The photocell used in the unit is a cadmium sulphide photo-resistor (PCC1) and together with R1 this forms a potential divider connected between the supply lines. The voltage at the junction of R1 and PCC1 depends upon the resistance of PCC1, which in turn depends on the light level to which this component is subjected.

IC1 is an operational amplifier which is used here in the inverting mode. R2 and R5 form a negative feedback network which sets the voltage gain of the

circuit; a high degree of gain is required in order to give the unit good sensitivity. The gain of the amplifier is approximately equal to $R5/R2$, or about 1000 times (60 dB).

The output from PCC1 and R1 is coupled to the input of the amplifier, but C2 provides blocking here so that the output from these components is of no consequence. However, rapid changes in the output voltage from the photocell circuit will be passed to the input of the amplifier, and will appear greatly boosted at the output.

The output from IC1 is coupled by C5 to a voltage-doubler rectifier circuit consisting of D1, D2, and C6. When the unit is activated, the positive bias produced across C6 is sufficient to bias Q1 into conduction, so that it energises the relay coil which forms its collector load.

RLA2 then closes and maintains the supply to the relay coil, so that once triggered, the circuit latches in the on state. The alarm or other controlled equipment is operated by RLA1.

SW2 can be used to break the supply to the relay, and thus reset the circuit. SW1 is merely the on/off switch. C4 is the compensation capacitor for IC1 and D3 is the normal protective diode. Maximum supply current is about 50 mA with the relay operated.

When constructing the unit, make sure that the input components of IC1 (PCC1, R1, R2 and C2) are kept physically separate from the output components (C5, D1, D2 etc) to avoid instability problems. If the unit is too sensitive for your application, reduce the value of R5 to decrease the sensitivity.

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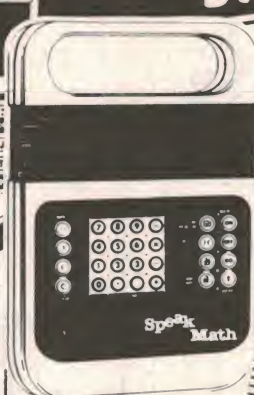


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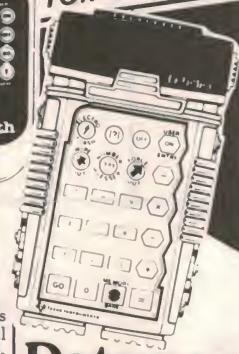
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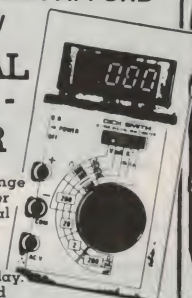
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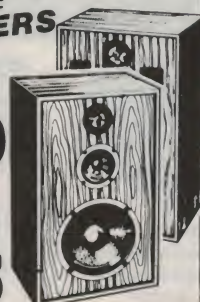
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12 inch
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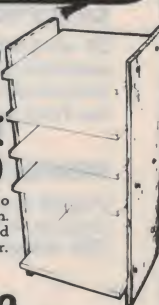
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What we are trying to say is that, if you are about to drive across town to pick up a particular line at a Dick Smith store, why not give the store a ring first (addresses and phone numbers opposite)... just in case! Thanks.

Dick Smith and Staff

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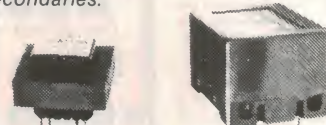
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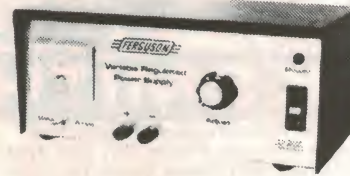
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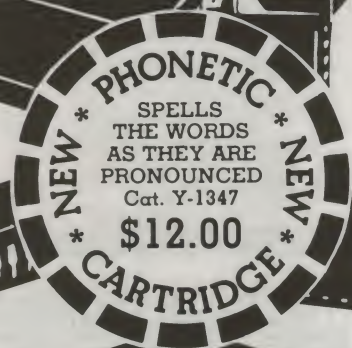
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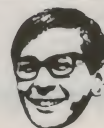
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A simple speed regulator for miniature dc electric drills

Graeme Teesdale

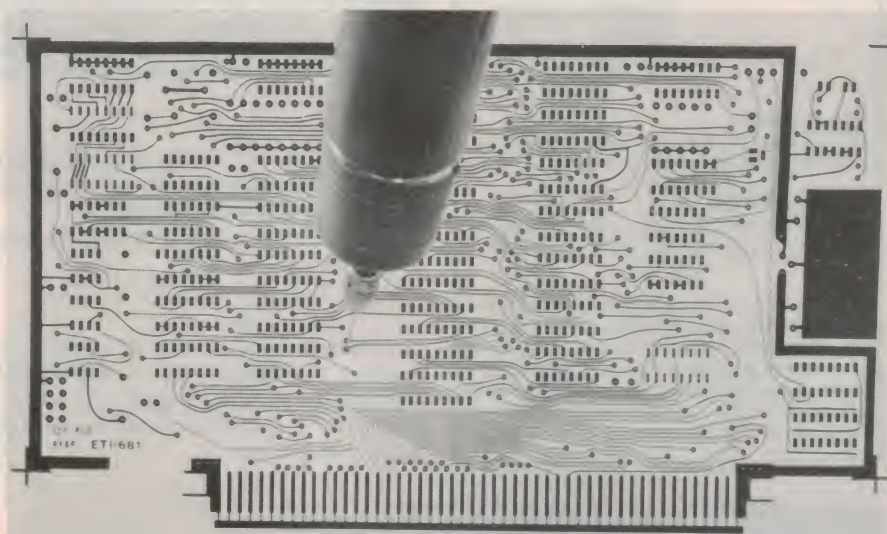
Mini-drills are inexpensive, handy and widely used amongst electronic hobbyists, servicemen and technicians. Their one drawback is poor speed regulation under load. This simple circuit fixes that!

'MINI-DRILLS' are widely used by a whole range of hobby and craft enthusiasts — electronics hobbyists, technicians, etc, finding them very useful for drilling holes in pc boards, deburring holes in panels and similar applications. Many mini-drills locally available incorporate a 12 Vdc motor and have a chuck speed of around 6000 to 10 000 rpm. Unfortunately, this tends to drop dramatically when you're trying to drill a pc board — particularly if it's a fibreglass pc board. Many are meant to be operated from batteries, often at a reduced voltage (and lower chuck speed, but fast enough for many applications). Operation is best with fresh batteries but the motor stall current can be as much as one amp. Operating current may be 200 mA or more under a reasonable load. The output voltage of most dry batteries 'sags' rather a lot under such loading owing to their internal resistance and the drill speed drops accordingly. The drill bit's efficiency therefore drops alarmingly and all of a sudden you have difficulty drilling the hole.

This project consists of a dc supply which senses the load on the drill motor by sampling the current drawn, then boosting the supply output to maintain the motor speed under load.

The problem, the solution

What causes the speed of the motor to drop when it is loaded? Normally, a



Perhaps the most common use for a mini-drill is drilling the holes for components in pc boards. It's a time-consuming job unless your drill has a suitably high chuck speed (over 6000 rpm) and good speed regulation.

fairly constant voltage is applied to the motor from either a battery or a fixed voltage power supply. When the motor is run without any load the speed increases until the power consumption is exactly sufficient to cover losses in the motor. When a load is placed on the motor, the speed drops, back-emf reduces and the difference between the back-emf and the supply voltage increases. This causes the motor

current to increase. A new reduced speed is reached when the losses of the motor and the power delivered to the load equal the increased power consumption. Since the motors in these mini-drills generally have a fixed flux magnetic field (i.e: permanent magnet stator), to increase the speed to the unloaded speed (or to increase the speed at all) the supply voltage to the motor must be increased.

Project 258

The circuit used in this project employs a standard three-terminal positive voltage regulator IC and a transistor differential pair in a feedback circuit to increase the output of the regulator under load. An LM340T5 (National Semiconductors) regulator was used here. A 7805 could equally well be used.

How's it used? Well, the output voltage of a 5 V three-terminal positive voltage regulator can be increased by returning the 'reference' (REF.) pin to

PARTS LIST — ETI 258

Resistors all ½W, 5% unless noted
 R1, R2 470R
 R3 0R22, 5 W
 R4, R5 100k
 R6 220R
 RV1 10k

Capacitors
 C1 2200u/25 V electro.

Semiconductors
 D1-D5 1N4004 or similar
 Q1, Q2 BC547
 IC1 LM340T/5 3-terminal regulator
 ZD1 12 V, 400 mW or 1 W zener

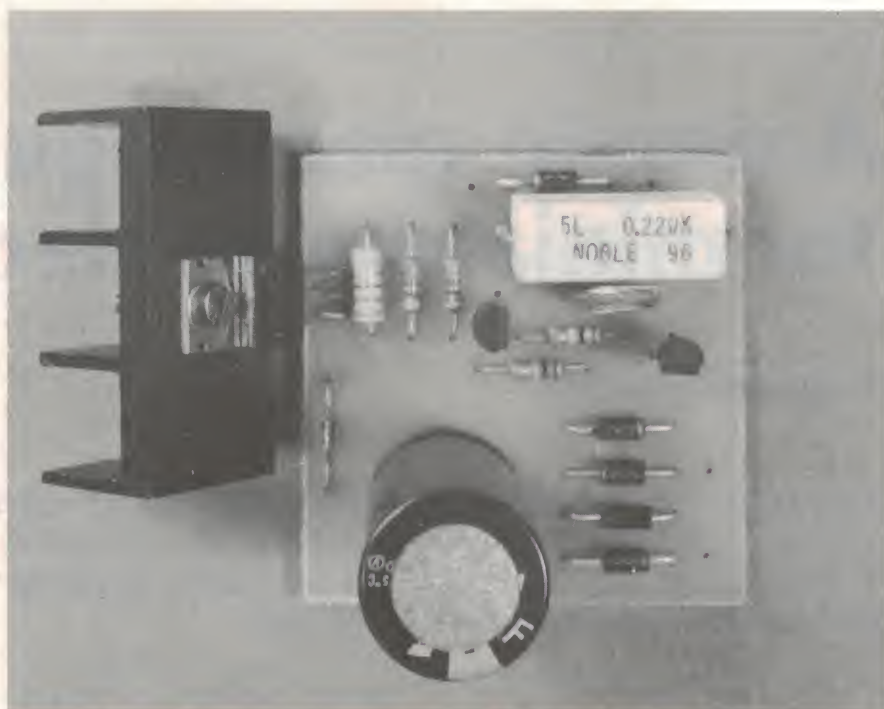
Miscellaneous
 ETI-258 pc board; 12-14 Vac supply (i.e. plugpack); wire; zippy box to suit, etc.

Price estimate

We estimate that the cost of purchasing all the components for this project will be in the range:

\$6 - \$8

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project such as — quality of components purchased, type of pc board (fibre-glass or phenolic base), type of front panel (if used) supplied etc — whether bought as separate components or made up as a kit.



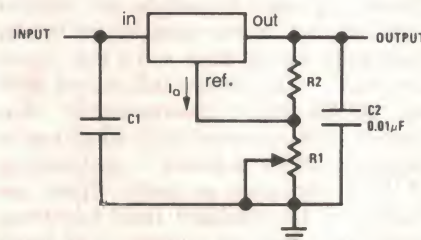
Construction is very simple — as you can see! The pc board is not absolutely essential, but convenient. The trimpot, RV1, visible just adjacent to the 0.22 ohm 5W resistor (R3), is adjusted to provide a nominal 12 Vdc at the output terminals under no load. Adjustment is relatively non-critical.

the junction of a resistive divider connected between the output terminal and 0 V, as shown in the circuit.

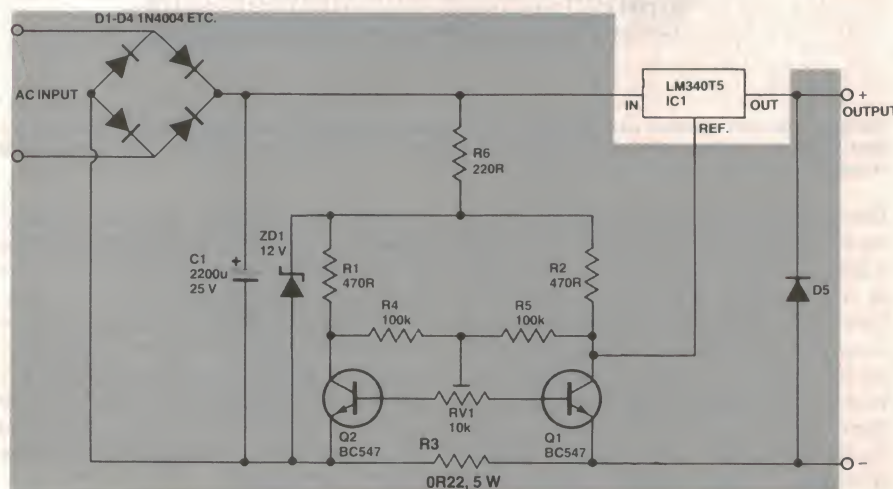
The output voltage is determined by the formula:

$$V_{out} = 5V + \frac{(5 + I_Q) R_1}{R_2}$$

The output voltage can be varied by making the resistor R1 in the circuit adjustable. In this project, R1 is replaced by a suitably biased transistor (Q1 in the circuit).



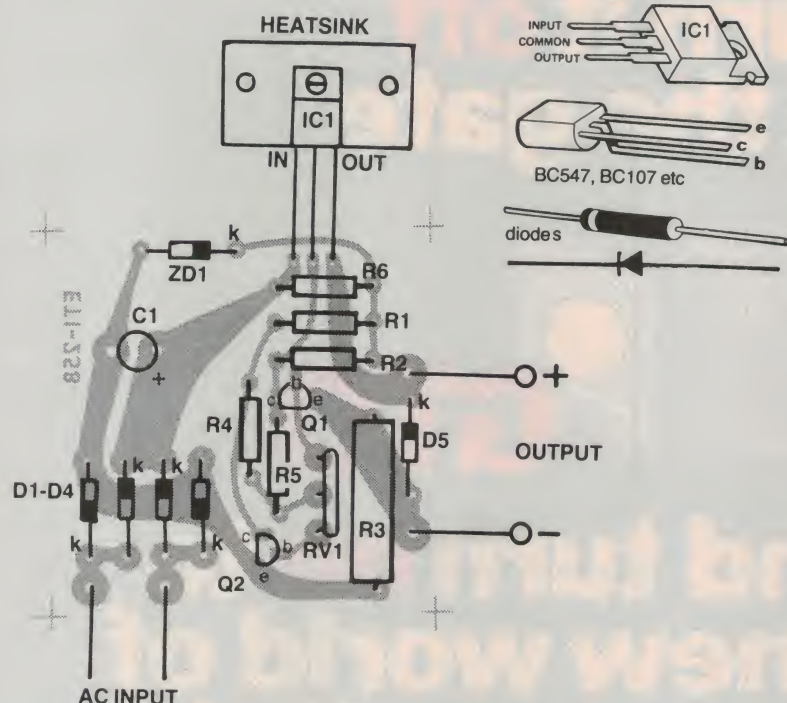
Showing how a three-terminal regulator can be arranged to have an adjustable output. The variable resistor, R1, here is replaced by a transistor in our regulator circuit below left.



Construction

Construction is quite straightforward, no tricks here. Using our pc board will ensure you have a compact unit that can be conveniently tucked somewhere out of harm's way. The pc board is not essential, however. Layout is not really critical, but keep all leads to and from IC1 short to prevent high frequency oscillation. If you have trouble with the latter, a 10n ceramic or greencap capacitor soldered directly between the output and reference pins of IC1 will cure the problem, although we didn't find it necessary. But that's getting ahead of ourselves!

mini-drill controller



Construction is best tackled by mounting all the resistors, diodes and transistors on the pc board first — leaving R3 till last as it's a bulky item. Watch the orientation of the diodes and transistors as usual. Mount C1 next. Mount IC1 last of all and then attach a small heatsink to it.

The completed unit can be housed in any convenient box or case, to suit yourself.

Supply input

The project may be supplied from any transformer, or a plugpack, that will deliver between 9 Vac and 12 Vac at 200 to 500 mA, or up to 1 A. A transformer such as the ubiquitous model 2155 (e.g. Arlec AR-2155 or Dick Smith

M-2155, etc.) will do the job nicely using the 9.5 V tap.

A dc plugpack may be used if you leave out D1-D4 and connect the plugpack's output directly across C1 (watch the polarity!). A 12 Vdc plug-pack rated at 200 mA or more would be suitable.

Although the mini-drill we used originally ran off two 1.5 V batteries (i.e. 3 V) it ran quite happily from our speed regulator. If you have to use the drill for prolonged periods, rest it at intervals so that the motor temperature does not rise too high.

HOW IT WORKS — ETI 258

A conventional bridge rectifier (D1 to D4) and capacitor-input filter (C1) provides dc input to the regulator circuit consisting of IC1 and Q1, Q2 plus associated components. Output with no load is set by adjusting RV1 for a nominal 12 Vdc at the output terminals. With the drill connected and operating the voltage drop across R3 causes Q2 to conduct more. As Q1 and Q2 are connected as a differential pair, the collector current through Q1 will decrease. This results in an increasing collector voltage on Q1. The reference pin of IC1 will be raised to a higher voltage with respect to the -ve line and the output voltage will increase.

Diode D5 is fitted to protect IC1 against back-emf spikes from the motor. There is no need to worry about the IC suffering damage from this source as it is internally protected. If you stall the motor, the maximum current delivered will be limited by IC1, which is internally protected to limit at a maximum current of 1 A.

Different voltage motors can be accommodated by changing the reference zener, ZD1.

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ETI-258



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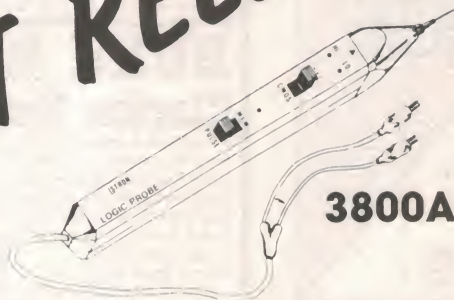
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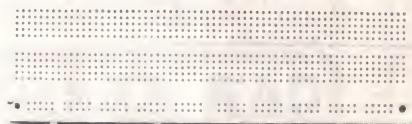
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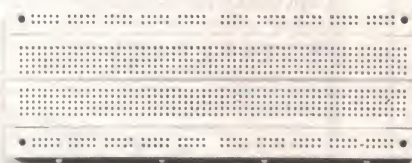
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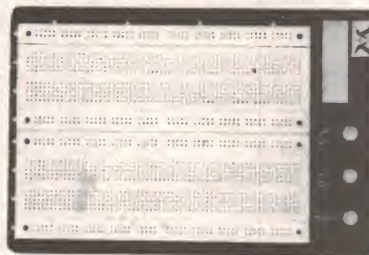
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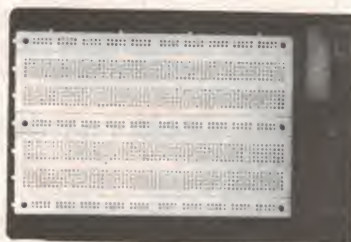


"Cut-away" view



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Five-mode logic pulser probe

Undoubtedly, one of the most useful and convenient test instruments for designing and trouble-shooting digital circuitry is the logic probe. However, regardless of its sophistication it can only observe the circuit under test. The solution to this problem is a logic pulser used in conjunction with the logic probe.

Philip J. Jones

A LOGIC PULSER is an instrument which injects pulses into a digital circuit. These pulses are of opposite state to the point being injected and are of very short duration to avoid damage to the logic element whose output is being forced to the opposite state. Ideally, both single pulses and pulse trains of various frequencies should be available.

The logic pulser has many uses. Say, for example, a four-stage binary counter is suspected of being faulty. A pulse to the reset pin will reset it; single pulses are then fed to the clock and the four outputs are observed with the logic probe. Any counting fault will become evident as the various counts are cycled through. If a seven-stage counter is under test, the pulses are most conveniently injected in the form of a pulse train of the required frequency. Further examples will suggest themselves during use.

The pulser described here operates from a wide range of supply voltages and is compatible with both CMOS and TTL ICs. It has five modes: a single



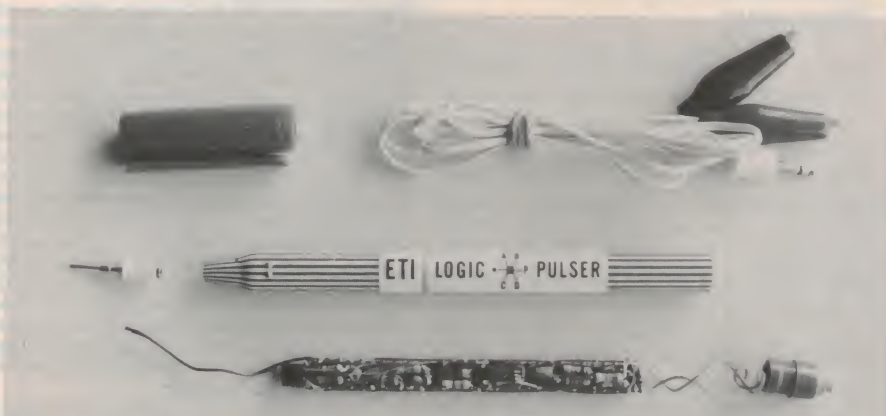
The completed probe — smart and business-like!

pulse mode and four pulse trains of frequencies 1, 10, 100 and 1000 Hz. The frequencies are largely dependent on the supply voltage, but in practice a precise value is not required. Single pulse injection and mode selection are achieved through the use of a touch switch. Briefly touching the switch injects a single pulse, whilst touching the switch for more than one second advances the pulser to the next mode. The current mode is shown on an LED display.

Pulse width is 4 μ s, which represents a compromise between the much shorter width acceptable for normal IC inputs and the longer width required for, say, an interrupt to a micro-processor. The pulser obtains its power from the power supply of the circuit under test, which is assumed to be sufficiently regulated and filtered.

Construction

Construction of the pulser is largely left to the reader due to the varying nature



The completed probe — but disassembled! No pc board is used, the components are wired directly together.

SPECIFICATIONS ETI-154

- CMOS or TTL compatible
- Supply voltage: 5 to 15 volts (18 V max.)
- Output impedance: approx. 10M
- Pulse width: 4 μ s
- Five modes:
 - single pulses
 - four pulse trains of approx. frequencies 1, 10, 100 and 1000 Hz
- Current mode displayed on seven-segment LED display
- Pulse injection and mode selection by single touch switch

Project 154

of pulser housings, etc, although a detailed description of the prototype construction is given for those who wish to make a normal pen-sized pulser. Many of the details given will be applicable to most forms of construction.

The pulser housing used was a Pilot "Ball Liner" pen obtainable from stationery stores, which has a length of 120 mm and an internal diameter of 8.5 mm. Whatever housing is chosen it is essential that it be made of plastic or a similar non-conducting material.

Direct point-to-point wiring has been employed in favour of a printed circuit board due to the prohibitive amount of space a board requires. To give the components the necessary support, a unique construction technique has been used. It involves the use of the ICs themselves to form the base for construction!

Firstly, the narrow part of the IC pins are cut off and the remaining stems are pushed up tight against the IC package. Then the corners of the top face of the IC are rounded. This is most easily done with an electric sander or grinder.

PARTS LIST — ETI-154

Resistors

R1	all 1/4W, 5%
R2	390k
R3	2k2
R4, R7	1M
R5	10M
R6	6M8
R8	680R
R9	1M2
R10	100k
	10k

Semiconductors

IC1	4081
IC2	40106
IC3	4017
IC4	4016
Q1, Q3	BC548
Q2	BC558
D1	1N914 or similar
LED.D	Small, common-cathode 7-segment display

Capacitors

C1, C2	150n/16V tantalum
C3	220n/16V tantalum
C4	10p ceramic
C5, C6	2n2 ceramic

Miscellaneous

Twin lead with black and red alligator clips or E-Z hooks; 2.5 mm plug and socket (optional); pulser casing, tip, and two pins.

Price estimate

We estimate that the cost of purchasing all the components for this project will be in the range:

\$9 - \$11

Note that this is an estimate only and not a recommended price. A variety of factors may affect the price of a project such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel (if used) supplied etc — whether bought as separate components or made up as a kit.



To fit inside the small pen barrel, each IC has the top ground down to a round shape and the pins cut back, as shown.

Finally, the IC packages are glued end-to-end with epoxy resin or other suitable glue. This procedure is really quite straightforward and is illustrated in the diagrams on page 56.

Now, a note on the vulnerability of the CMOS ICs involved. CMOS technology has come a long way since it was first introduced and as a result the chance of an IC being damaged by the above procedure is very small. Nevertheless, as a safeguard against later disappointment, it is advisable to check the ICs at this stage.

The next step is to mount the components and wire up the circuit. As far as the components themselves are concerned, they are best purchased over the counter so that the smallest of each can be selected from the supplier's stocks. It is surprising how much the size can vary of, say, tantalum capacitors of the same value from the same manufacturer. The hookup wire should be the single strand, plastic-coated type and have a total thickness of about 0.5 mm.

The component leads should be bent and cut before soldering with a minimum of solder. It is important to hold, rather than press, the components in position while soldering, as joints soldered under stress may come apart. With care, all the components including the LED display can be mounted on top of the IC base except for the output transistors and the zener diode, which are best mounted at either end. The transistors may be filed down to make fitting easier.

At this stage, the unit should be tested. Upon applying power, segment 'd' should light up, and briefly touching the two touch wires should result in a pulse at the output. Advancing to the pulse train modes should result in the corresponding LED segments lighting and the corresponding pulse trains appearing at the output. Finally, after the 1 kHz pulse mode, the pulser should return to the single pulse mode. If some, or all, of these functions fail to work correctly, read the circuit description and track the fault down with a multi-meter or logic probe. The most likely faults are incorrect wiring and dry joints.

With the pulser now functioning correctly, construction of the housing can proceed. This involves providing a window for the LED display and fitting the contacts for the touch switch. The display window can be provided as follows: drill an oversized hole with diameter, say, 4-5 mm. Insert a soft, transparent plastic disc (the plastic used in Kodak slide boxes is ideal) of sufficient diameter to ensure a tight fit. Due to the curvature of the housing, the disc will have protruding edges which can be trimmed with a razor blade. Finally, a paper label with the correct sized window cut in it can be fixed over the disc with Contact or a similar transparent, adhesive plastic covering. The circuit should be fitted in place before the plastic disc is positioned. The purpose of the oversized hole masked by the correct-sized paper window is to reduce the precision required when positioning the circuit and LED display.

The contacts for the touch switch are made from two pins. Cut each pin about 3 mm below the head. Then solder fine

HOW IT WORKS — ETI-154

In the single pulse mode, touching the touch switch contacts makes the output of IC2a go low, with R1 and C1 eliminating switch bounce. The output of IC1b then goes low, producing a short, positive pulse at the output of IC2b. The pulse width is determined by R2 and C5 and is approximately 4 μ S. This pulse is then fed to the two AND gates, IC1c and IC1d, one of which is enabled and thus switches on the appropriate output transistor. The AND gate enabled is determined by the state of the point being injected. If it is high, the output of IC1a is high, which enables gate IC1d through R3. Thus, TR3 turns on and injects the required negative pulse. The complementary situation occurs if the point being injected is low. The RC combination, R3 and C4, prevents the pulser from responding to its own pulses. Base resistors are not required for the output transistors due to the very short pulse width.

In the single pulse mode of operation, the zero output of the 4017 is high, which closes switch IC4d, thereby disabling the Schmitt oscillator. However, touching the switch for more than one second charges C2 sufficiently to cause the output of IC2e to go high, which advances the 4017 counter. Switch IC4d opens and IC2f begins to oscillate at 1 Hz. The square wave at the output is fed to the remaining input of IC1b and hence a 1 Hz pulse train is injected.

Further advancing the counter increases the pulse frequency by switching in resistors R8 to R10. The counter outputs are also used to drive a seven-segment LED display, which indicates the current mode. The '5' output (pin 1) from the counter is connected to the reset input, hence returning the pulser to the single pulse mode. Capacitor C6 ensures that the pulser will come on in the single pulse mode when the power is applied.

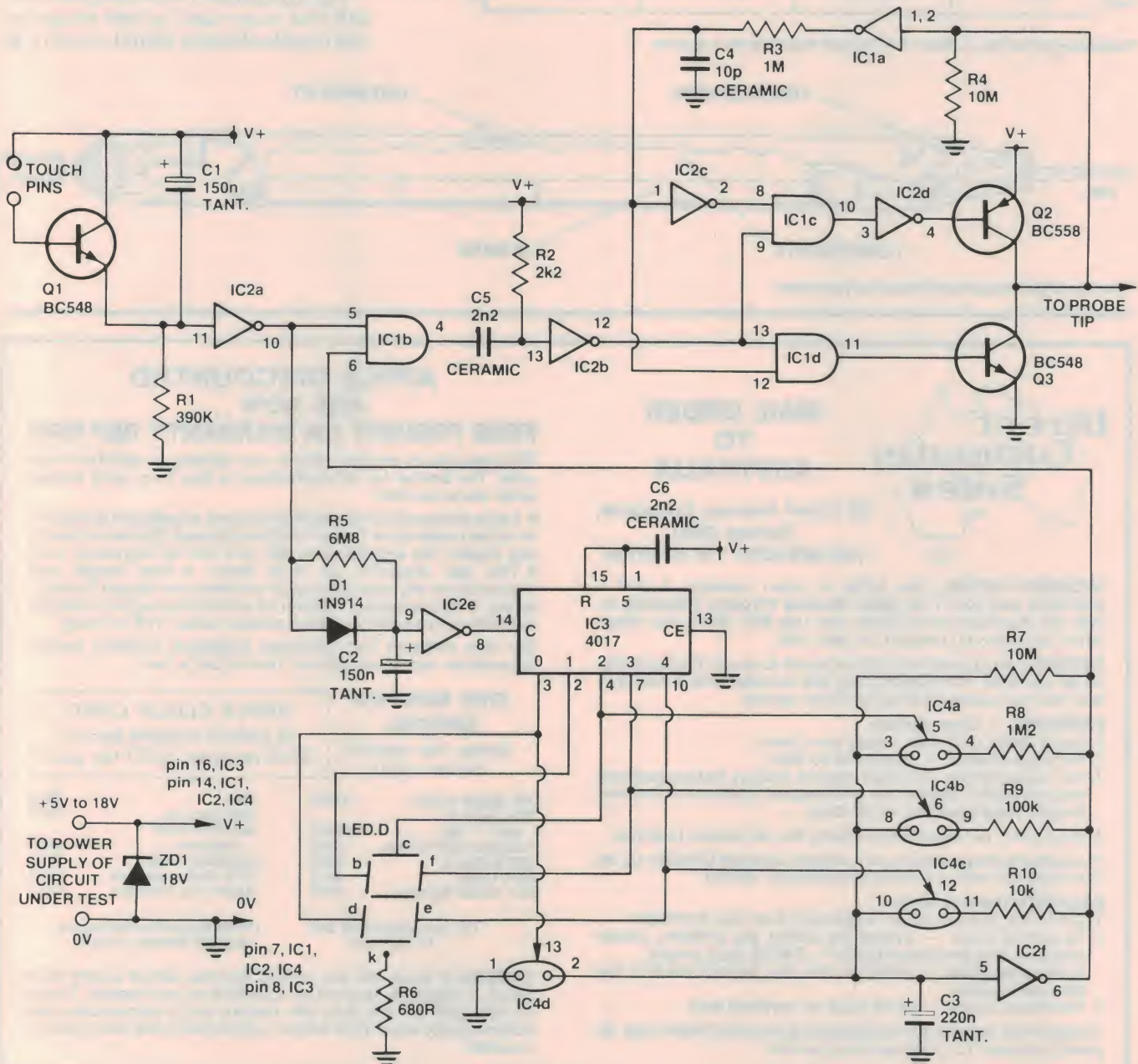
Zener diode, D1, provides overvoltage protection and reverse polarity protection should the power be incorrectly applied.

logic pulser probe



Close-up of the completed unit. Connections to the probe tip and the touch contact pins are to the left, power supply connections to the right. All the components are wired directly in place and small gauge insulated hookup wire used for interconnections. The ICs are glued end-to-end to form a solid

'base'. This form of construction is only necessary if you wish to construct the unit and house it in a pen barrel as the author has done. Otherwise, matrix board could well be used to support the components.



Project 154

enamelled or silk-covered wire to the bottom of the cut pins, ensuring that the resultant joint is not appreciably larger in diameter than the pin itself.

Drill two holes of appropriate diameter and spacing in the housing near the tip. Feed the wires from the pins through the holes and out the tip end and push the pins in position. Lightly touching the pinheads with a clean iron tip will set them in position.

The pulser tip used in the prototype was a gold-plated pin from a computer

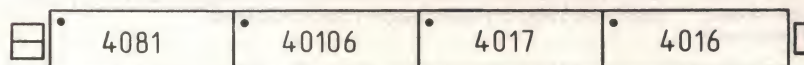
plug. It certainly looks the part, but a metal darning needle or similar object could equally well be used. The original plastic tip from the pen can be drilled to fit the tip chosen and the whole lot glued at the appropriate stage.

The circuit can now be positioned. The two wires from the touch switch circuitry should be of the type used for the pinheads and both these wires and the pulser tip wire should have lengths longer than the pulser housing. These three wires can be fed through the

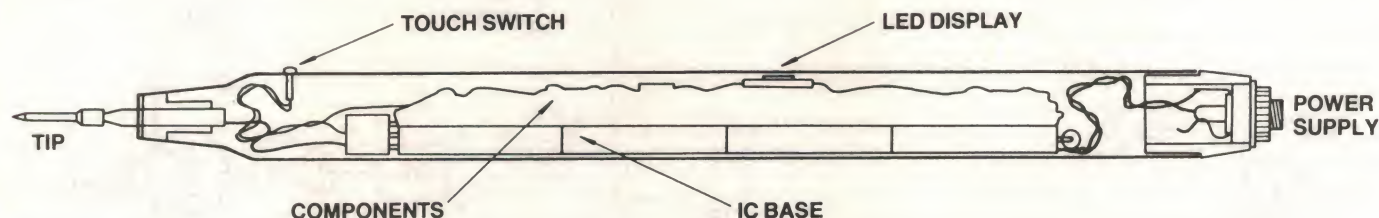
housing and the circuit then pushed into position with the LED display below the oversized hole. The five wires now protruding from the tip end can be cut to 20 mm length and the four touch wires paired, soldered, insulated, and pushed back into the housing. The remaining wire is soldered to the pulser tip, which is then glued in place. The LED display window is completed as previously described.

The two power supply leads are terminated with a 2.5 mm socket. This enables leads of various lengths with various clips to be substituted; however, the use of the plug and socket is optional.

The logic pulser is now complete, and will find many uses, in both designing and trouble-shooting digital circuitry. ●



Positioning of the ICs, bottom view. The dot indicates pin 1 on each.



Location of the components inside the pen barrel.



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Lab Notes

Attenuator ups and downs

One of the most important types of artillery in the design engineer's armoury of 'vital weapons' is the apparently simple passive circuit known as the 'attenuator'. Naturally, these apparently simple weapons are full of nasty little surprises and have a tendency to explode in the face of the unwary designer, says Ray Marston.

Ray Marston

ATTENUATORS are used to reduce an awkward value input or output signal to a lower and more convenient level. The simplest example of a practical attenuator is the 'pot' circuit of Figure 1, which may be used as a volume control in an audio system or as an output level control in a simple audio generator, etc.

The input signal to the pot attenuator is connected across the total resistance chain and the output is taken from the pot slider. Note that the pot effectively comprises an upper (R1) and a lower (R2) resistive arm, thus forming a basic 'L'-type attenuator, and that the degree

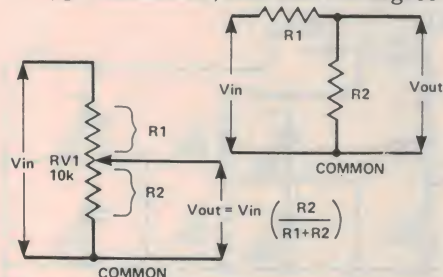


Figure 1. A simple 'pot' attenuator, as used for a volume control or an uncalibrated output level control (left) is a common version of the 'L' attenuator (right).

of attenuation is determined by the ratio of lower arm resistance divided by the total resistance.

The precise amount of attenuation

provided by a pot is generally of little importance and the control is usually left uncalibrated. If a precise amount of attenuation is required, a simple switched potential divider network of the type shown in Figure 2 may be used. It is important to note, however, that this circuit is designed to feed into an *infinite* impedance, or at least one that is very large compared to the total resistance of the divider chain.

Design tips

The first step in designing an attenuator of the Figure 2 type is to decide what its input impedance or total resistance is to be. Next, the values of the individual resistors are determined. Here the design is carried out in a simple sequence of logical steps, there being as many steps as there are attenuator switched positions. In each of these steps, the circuit is considered to consist of an upper and a lower half only. An example will help clarify matters.

Assume (as in our example) that the total resistance is to be 10k and that two attenuation positions (excluding unity) are required and are $\div 10$ and $\div 100$. The values for the greatest amount of attenuation are always determined first, so for $\div 100$ the lowest arm must contain 1/100th of the total resistance,

or 100R. This gives the value for R3 and leaves the remaining 9900R in the 'upper' (R1 + R2) arm.

The values for the $\div 10$ position are next calculated and it is found that 1k is needed for the 'lower' arm. In this case, however, the 'lower' arm consists of R2 + R3, but as R3 is already known to be 100R, R2 must be $1k - 100R = 900R$. The upper arm, R1, must obviously contain the remaining 9k of the 10k chain.

This simple design procedure may be expanded up to give as many attenuator steps as are required for a particular application.

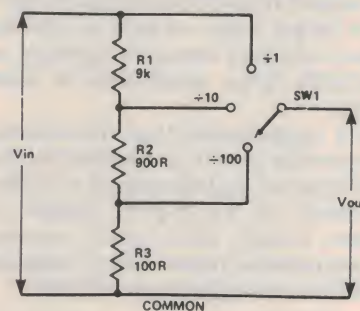


Figure 2. The method of designing this simple switched attenuator is explained in the text.

It should be noted that the simple attenuator circuit of Figure 2 is only accurate at low frequencies or when

Lab Notes

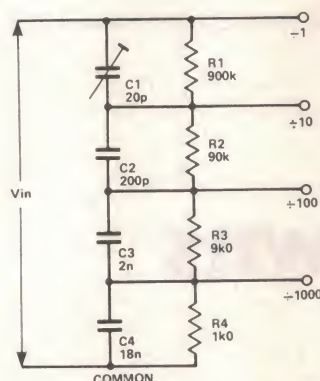


Figure 3. A method of providing frequency compensation (to give a wide frequency response) to a simple attenuator network.

moderately low values of resistance are used. At high frequencies, stray capacitance will shunt the values of all resistors and may significantly reduce their values and thus the accuracy of the attenuator. This effect is particularly acute when high value resistors are used: a mere 2 pF of stray capacitance represents a reactance of about 800k at 100 kHz and will have a very significant shunting effect on any resistor with a value greater than a few tens of kilohms.

Compensation

This problem can readily be overcome by shunting all resistors with correctly chosen values of capacitance, as shown in Figure 3.

Here, each resistor of the chain is shunted with a fixed capacitor, the reactance values of capacitance being in the same ratios as the resistive arms of the attenuator. The highest reactance (smallest capacitance) is connected to the largest resistor and typically has a value being large enough to 'swamp' strays but small enough to present an acceptably high impedance to input signals.

This 'compensated' type of attenuator is invariably used in 'scopes and various other types of high frequency test gear, as shown in the typical circuits of Figures 4 and 5. Once again, note that the compensated attenuator is intended to feed into a high impedance load.

Pot pitfalls

At this point in our discussion it may have dawned on you that, because of the effects of stray capacitance, there can be certain pitfalls in using pots in some

types of circuit. Suppose, for example, that you have designed an audio amplifier with a beautifully flat frequency response but have, in a moment of madness, fitted it with a 500k volume control. You will (hopefully) not be unduly surprised to subsequently find that, at low volume settings, stray capacitance of a few picofarads across the upper arm of the pot causes the amplifier's treble response to be boosted by several dB at 12 kHz or so!

Again, suppose that you have designed a superb LF sine/square generator which produces square waves with rise and fall times of a mere 50 nS or so, but have fitted the beast with a simple 10k pot as an output level control. Naturally, you will not be surprised to find that the few picofarads of strays across the upper arm of the pot act as a reactance of only a couple of thousand ohms to your fast rise and fall time signals and consequently cause

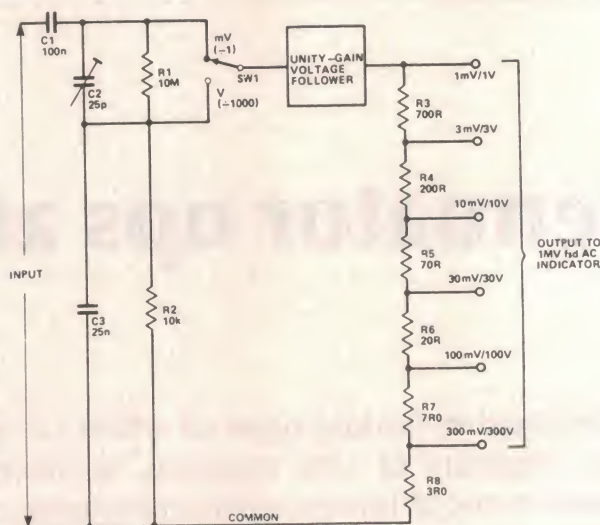


Figure 5. Typical attenuator sections of an ac millivoltmeter.

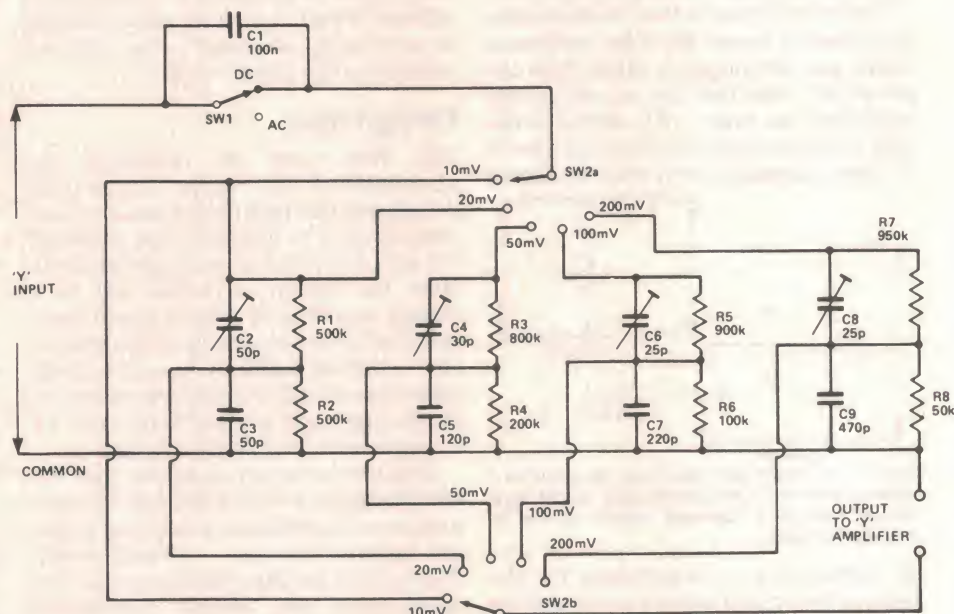


Figure 4. Section of a typical scope 'Y' amplifier attenuator.

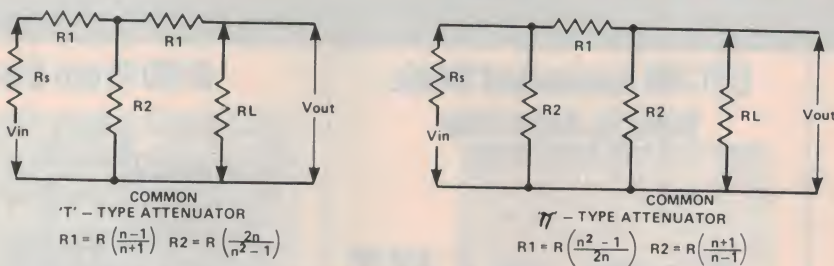


Figure 6. Two popular types of matched-resistance attenuator.

your square waves to appear incredibly 'spiky' at low amplitude settings.

Both of the above problems can be solved or minimised by using pots with sensible low resistance values, bearing in mind the effects of strays at the operating frequencies in question.

Matched-resistance attenuators

Often, an attenuator is needed to feed into and/or from a fixed load of some kind, in which case the simple potential divider types of circuit discussed above

are of little use. Instead, one of the many versions of the so-called matched-resistance attenuator must be used. Two of the most popular attenuators of this type are shown in Figure 6, together with their basic design formulae. Note that these formulae are valid only when the attenuators are correctly terminated at each end.

The 'T'-type attenuator is a perfectly simple design and several sections can readily be cascaded to form variable attenuator networks, as shown in the practical circuit Figure 7. Here, the attenuation can be varied from 0 dB to 60 dB in 20 dB steps by switching individual sections into or out of the circuit.

The π attenuator sections cannot be directly cascaded, as is made clear in Figure 8. Nevertheless, sections can be cascaded in modified form to produce a ladder attenuator network, the most popular of all attenuator types.

Looking at Figure 8, you can see that if three individual π sections are wired in cascade (Figure 8a) their adjacent R2 sections connect in parallel to give an impedance of P/2 (Figure 8b), while the two R2 end sections have impedances of P. If an external load, RL, is simply switched to the different outputs of the cascaded π attenuator sections (Figure 8c) the load will clearly see impedances of roughly half of the correct value and so be severely mismatched. To put things right, the formula for the component values of the ladder network of Figure 8c are re-jigged as shown.

The ladder attenuator of Figure 8c is very widely used in AF and RF signal generators. Figure 9 shows the practical circuit of a fully variable 600 ohm attenuator that can be used in sine/square generators, etc. The odd resistor values (correct within 2%) can be made up by wiring pairs of resistors in series or parallel.

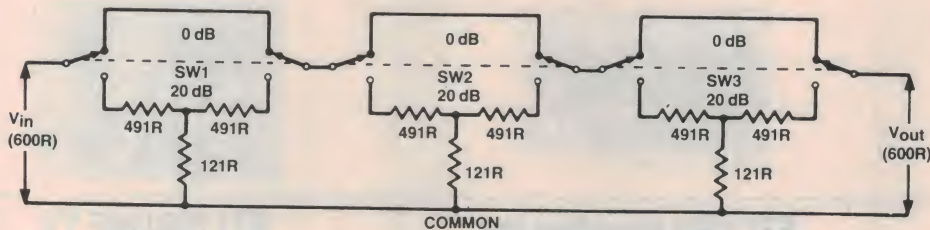


Figure 7. Three identical 20 dB 600R 'T' attenuators cascaded to make a 0-60 dB switched attenuator unit.

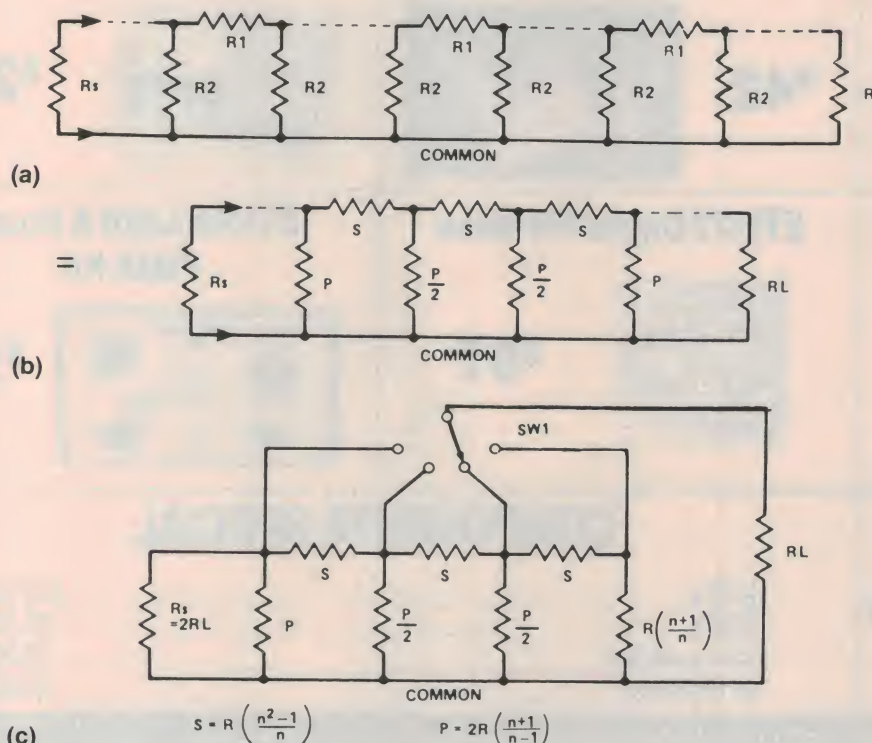


Figure 8. The ladder attenuator (c) is a development of the basic π attenuator (a and b).

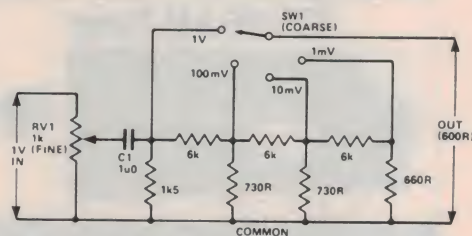
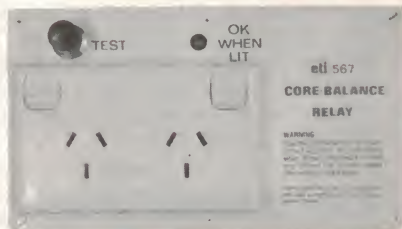


Figure 9. Practical 600R output attenuator network for a modern sine/square generator. RV1 gives fine control. SW2 gives coarse control.

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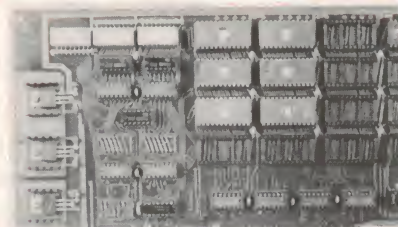
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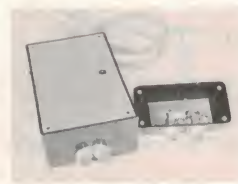
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Ideas for Experimenters

These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.

VLF ramp generator

It is always satisfying to exploit the otherwise unwanted property of a device — the reverse bias current of a leaky germanium diode, in this circuit from **G. Malloy of Whitby, UK**.

The reverse saturation current is typically a few microamps for the OA90 and is relatively constant over 2-10 V. This constant current is used to linearly charge the capacitor in the relaxation oscillator built around the 741.

When the diode becomes forward biased the capacitor is rapidly discharged by the limited output current of the op-amp. Frequencies below 0.01 Hz are possible, though measures may have to be taken to improve the linearity of the ramp.

PR1 allows some degree of dc offset of the ramp, and the source follower (Q1) reduces the loading on the capacitor, which tends to degrade the ramp's linearity. For the same reason tantalum or RBLL electros (i.e. low leakage) types should be used for large values of C1. Linearity can be further improved by the use of a FET input op-amp such as the 3140.

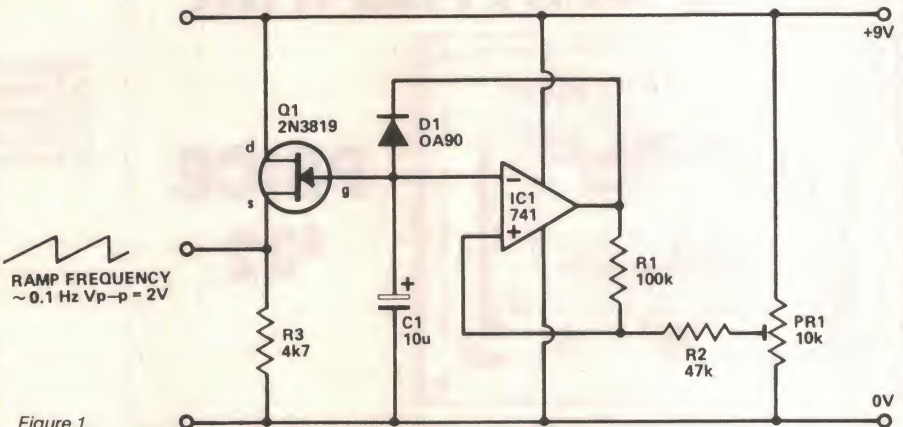


Figure 1.

The frequency can be made variable by using the FET constant current generator shown in Figure 2, which should replace the diode, D1. With RV1 at 100k the current will be about 30 μ A and roughly inversely proportional to RV1. This constant current generator needs a voltage of about 3 V to function well. This may require an increased power supply. However, the resulting linearity is excellent, especially with the suggested FET input op-amp.

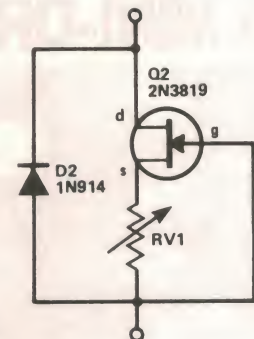


Figure 2.

Cheap micro music box

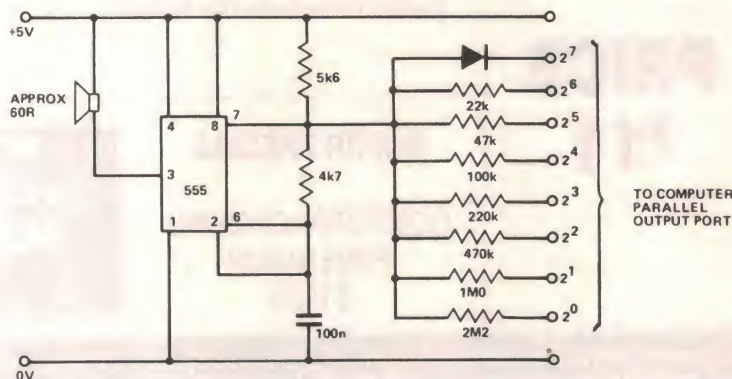
This circuit may be connected to the output port of any micro to generate musical notes over a range of about 1½ octaves. On/off control is provided by the most significant bit and the resistors provide seven-bit resolution.

Alternative on/off control methods can be used to give eight-bit resolution, e.g. by using the handshake lines, if available.

If the diode is replaced by a resistor, say 10k, it will be found that below a

certain output value the voltage at pin 7 is insufficient to charge the capacitor. Thus the sound can be switched off.

The resolution is sufficient to enable values to be found corresponding to tones and semitones throughout the frequency range. Current consumption depends largely on the loudspeaker impedance and is generally low enough for power to be taken directly from the computer.



ERRATA

A rather obvious, but potentially dangerous error occurred in the circuit on the top left of page 60 ('Power Monitor') in the March issue. It shows the mains active input connected to the earth at the output. The mains active input should instead go to the fuse. Correct your copy now. Correction slips were inserted in the majority of copies distributed.

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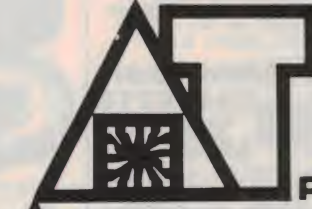
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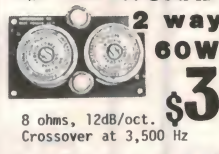
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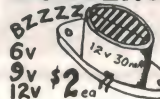
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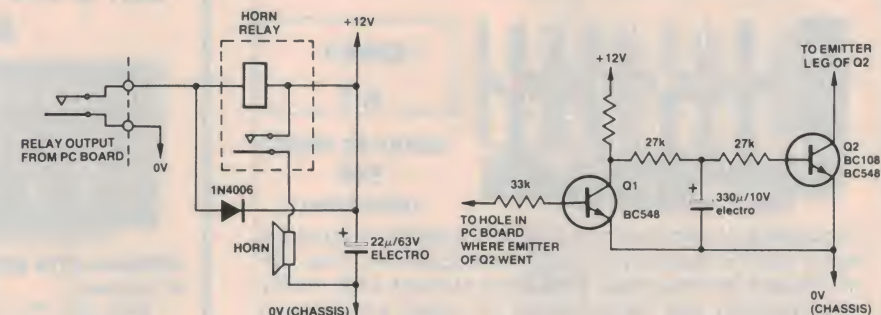
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Ideas for Experimenters

ETI-084 car alarm mods

A number of readers, including the **Service Manager at Dick Smith Electronics, Gary Crapp**, have sent along suggested modifications for this alarm, which was published in our 'Project Electronics' book and has been quite a popular kit.

The principal problem observed was that the alarm would reset itself after tripping and operating the vehicle's horn. There are several suggested methods of curing this. Gary Crapp suggests linking pin 4 and pin 8 on each 555 (IC1 and IC2), adding a 100nF capacitor between pin 5 of IC1 and the +12V rail and adding a 1000 uF capacitor across C1. **Geoff Sinclair of Williamtown, NSW**, cured it by adding a 25 uF capacitor from pin 5 of IC2 to the 0V rail and adding a 4u7 capacitor from pin 2 of IC1 to the 0V rail. He also in-



creased the value of C3 to 25 uF.

Rodney Hunt of Oyster Bay, NSW, cured the resetting problem by adding a horn relay (which helps the project's on-board relay to survive longer) and a 22 uF capacitor in the circuit shown here. He also replaced C3 with a 100 uF capacitor (giving an exit delay of seven seconds). By increasing C4 to 22 uF, Rodney also increased the reset time to almost two minutes.

Entry delay can be provided in several ways, but that suggested by Rodney Hunt is the simplest we've seen. The second circuit here shows how it's done. The emitter leg of Q2 on the pc board is lifted and this circuit inserted between that leg and the hole it went into (to pin 3 of IC1). This provides an entry delay of around seven seconds. Rodney constructed the circuit addition on a piece of tagboard.

Parametric equaliser

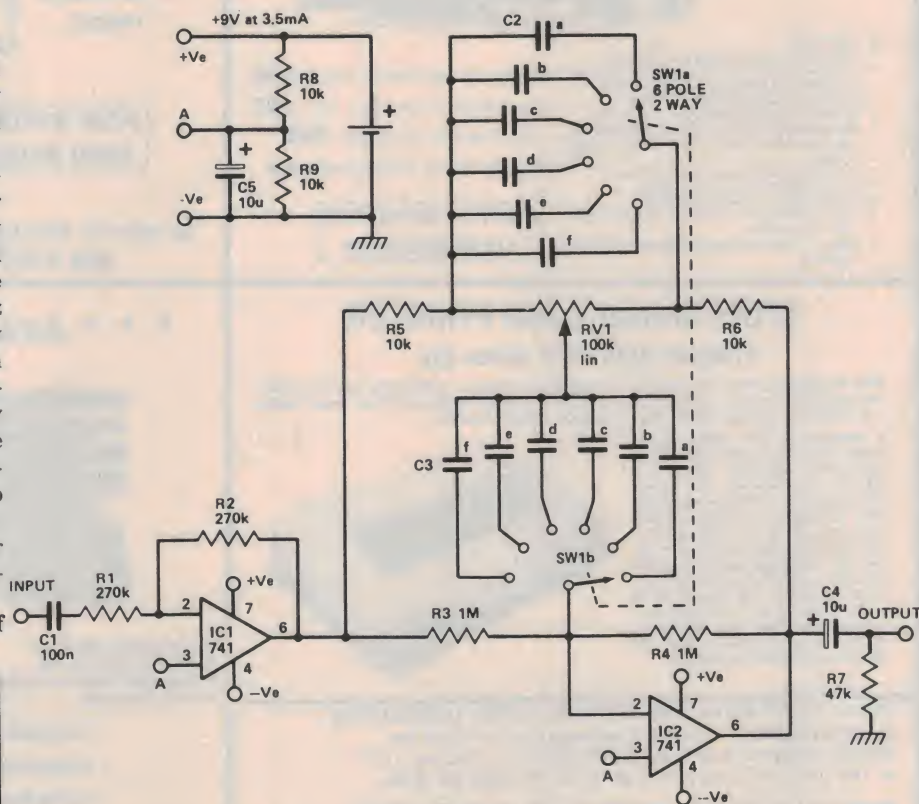
This parametric equaliser offers six bands of tone control separated by an octave in frequency, each frequency band being selected by the six-position rotary switch.

Potentiometer RV1 permits the selected frequency band to be boosted or cut by 12 dB. The filter is particularly ideal for use with a guitar to modify and enhance the tonal qualities of the instrument. For example, the 500 Hz setting with cut gives a hollow funky sound, whilst the 500 Hz setting with boost gives an overdriven valve amplifier the raunchy sound favoured by many rock guitarists, but without the unpleasant, muddy, harsh sound resulting from boosting the entire audio frequency spectrum.

Capacitor values for the filter frequencies are given in the accompanying table.

A neat idea from **C.E. Read of Norwich, UK**.

	FREQ (Hz)	C2 (pF)	C3 (pF)
a	125	47000	4700
b	250	22000	2200
c	500	12000	1200
d	1k	5600	560
e	2k	2700	270
f	4k	1500	150



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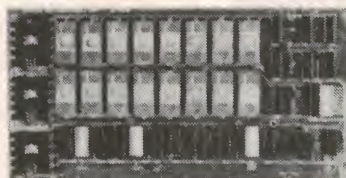
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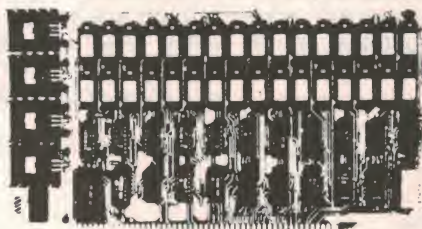
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6. On board wait state circuitry if needed.
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9. Gold plated contact fingers.
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12. Easy and quick to assemble.

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4. ON BOARD SELECTABLE WAIT STATES
5. Double sided PC Board with solder mask and silk screened layout Gold plated contact fingers
6. All address and data lines fully buffered
7. Kit includes ALL parts and sockets
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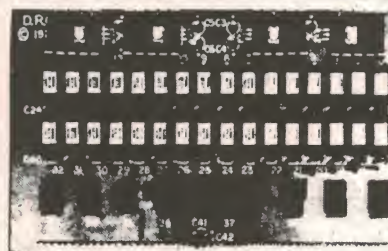
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LETTERS

Dear Sir,

I am in the process of constructing the ETI-475 AM tuner. I would like to be able to switch the whistle filter in and out of circuit. Could you suggest (with a circuit) how to do this please? Also, I have heard of "stereo" adaptors being used on AM tuners and TV sound. Have you any information on these, and could you run a project on one of these, please, for the "poor" country listeners?

Thanks for the article on the Negative Ion Generator. I am building several of these at the moment although mine are straight from the mains (similar to the Aironic — courtesy DSE!) at a cost of about \$20 each. I had held off buying the parts, until your article appeared. Don't worry — I was an electrician earlier on in the piece and still intend to buy ETI for a long time yet!

Many thanks also for the article on the Portable Core-Balance Relay — I have waited a long time for this project and wish I had had one on several occasions in the past. At well under half the price of a commercial unit it has to be a winner!

Now for the most useless idea of the year for a computer (not fit even for DREGS)! The bane of many commercial TV station watchers (this includes some ETI readers) are the commercial breaks. The affluent have their remote handheld control and can immediately and easily censor at least the sound.

My suggestion:

As ads are repetitious (subtle brain-washing), it should be possible to develop software to cover every ad on TV. With a home computer thus suitably armed, within a short time of each ad commencing it will take the appropriate action (e.g. turn over to AM or FM music etc) and then revert back to TV sound at the end of the ads. We have the technology, all that is needed now is someone with the knowledge, and time to waste on developing software to do this. This problem has bugged me for many years and perhaps the end is in sight!

On a more serious note, as there are now various colour LEDs available (red, yellow, orange, green), I would like to see a project on a Power Point Safety Tester. The commercial type uses NE-2s. It should be possible to build one into a side entry three pin plugtop (HPM 106 or Clipsal 418) and plug the entry hole. The "hinged" flap could be drilled easily and

the LEDs glued into place. A suitable chart could be arranged showing the various possibilities and faults.

Anyway, congratulations on a bumper tenth birthday issue of ETI and I hope there will be some more competitions this year. You will have to make them a little harder — too many people are getting all the answers correct, particularly those city people with the big libraries!

**Brian Connors
Gunnedah NSW.**

Thanks for the complimentary remarks about our April issue, Brian, we hope you find many following issues just as stimulating and useful.

With regard to the whistle filter in the ETI-475 Quality AM Tuner (Sept. '80 issue), a simple switch connected in parallel with L3 should suffice. The switch could be mounted on the front panel of the unit and connected to L3 via either a short length of shielded cable or tightly-twisted pair made from hookup wire. Any slight effect on the tuning can be compensated for with the adjuster in L3.

We don't recommend operating the Negative Ion Generator high voltage board direct from the mains. It is dangerous and the output voltage is too low for effective operation of the emitting head.

Now, as for the 'ad-killing computer' — firstly, there are those that would not share your opinions about advertisements (nuff said!) and secondly, what you're asking is a tall order indeed involving lots of fast memory. Would you be prepared to pay the enormous cost of such a device for the (to you) peace of mind? There is a simpler way, but the ad-killing is done by you. The ETI-599 Infrared Remote Control Unit can be arranged such that its output relay turns off the TV set's audio, rather than switching the mains to the unit's output socket.

Your suggestion concerning a power point safety tester is a good one — keep your eyes peeled. As for contests, it seems the harder they are, the more readers like them! We've a great contest this issue with a Radofin 'Adam 180' Teletext adaptor as a prize. Sharpen your wits!

**Roger Harrison
Editor**

Dear Roger,

Just a brief note of praise from an overseas traveller. As a subscriber to ETI back in Canada, I was quite pleased to see my favourite electronics magazine (I reckon the best!) in various Australian newsagencies. In your April '81 edition, I was quite surprised to discover, though, that the Australian ETI edition was the 'parent' of several international versions, including the Canadian one. So much for North American snobbery! I must say that ETI's ten years in Australia have produced a high quality, comprehensive and thoughtful magazine for electronics enthusiasts. Indeed, in comparison, Canada's ETI, and it would seem its retail electronics industry in general, are growing infants. There is so much more readily available to the enthusiast in Australia.

Keep up the fine work! I just might break down, ignore the exchange rate (ouch!), and subscribe to both editions!! All the best.

**David Finley
Willowdale, Ont., Canada**

Dear Sir,

I have read ETI from its very first issue, not missing one. I also have read your competition for almost two decades. In case it has escaped your attention, they are now featuring a surprising number of projects which are repeats of projects previously published by them, albeit with the occasional update in the face of new technology. The high standard of originality and independence of your magazine is thus illuminated even more clearly. I congratulate you.

'Loyal Reader'

Well, thank you, L.R. — but we're not entirely faultless, either. In the two years between April 1979 and April 1981 we published a total of 95 projects (not counting items such as 'Short Circuits'). A total of six were repeats, generally of projects four years old or more. We'll try and do better in the next two years.

**Roger Harrison
Editor**

THE AFFORDABLE HOME COMPUTER



When the System 80 was first introduced to Australia, the response was overwhelming! The Computer World was **ASTONISHED** at the **QUALITY**, as well as the **PRICE**. In fact, the System 80 has more features than the TRS-80, but with a price tag that is substantially less!

Microsoft's Level II BASIC and 16K Memory.

Another reason for all the commotion is that the System 80 uses the same, easy to learn, **LEVEL II BASIC** language that the TRS-80 uses! What does this mean? It means that the System 80 can run most of the 1000's of programs that have been written for the TRS-80 Level II, 16K computer! This means that you have scores of games, educational programs, business programs, simulations etc, that can be used with the System 80.

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Your System 80 is ready to grow with your needs. The S-100 Expansion Interface enables lots of other "goodies" to be interfaced to the System 80. For example, you can control up to 4 disk drives, there is a full Centronics-type parallel printer port, RS-232C serial communications port plus two vacant S-100 card sockets. All of this for \$499 (X-4010) plus if you want further RAM memory you can get a 16K card for only \$199 (X-4016) which has provision for a further 16K to be added for only \$59.95 (X-1186).

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Comparison Chart			
Parameter	Syst. 80	TRS-80	
CPU Type	Z-80	Z-80	
Speed	1.7MHz	1.7MHz	
S-100 Compatible (with expansion unit).	Yes	No	
RAM (basic computer)	16K	16K	
Built-in Cassette Recorder	Yes	No	
Built-in Video RF Modulator	Yes	No	
Capacity of BASIC ROM	12K	12K	
Cassette Recorder Ports (basic machine).	2	1	
Motor Control for Cassette Recorders.	Yes(2)	Yes(1)	
Cost of basic unit with 16K RAM, video monitor & cassette recorder *	\$899.50*	\$1169	
* The Basic System 80 costs only \$750. As this computer can connect direct to your TV set a video monitor, as a separate entity, is not required: making the saving on TRS-80 prices even greater!			

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The System 80 microcomputer with 16,000 characters of "In Computer Memory", Microsoft's Level II BASIC (built into the computer), a cassette player for storing or retrieving programs or data (cassette player is built into the computer!), an RF modulator for connecting the System 80 to your TV set (can also be connected directly to a video monitor, see our X-1196 @ \$149.50), complete instruction manual, learning manual and owners manual so you can begin to write programs straight away, plus a demonstration cassette with 5 programs (Cost Analysis, Graphics, Statistics, Biorhythm, and Star War).

ORDER TODAY!

4K RAM Cat. X-4003

\$695

16K RAM Cat. X-4005

\$750

**DICK SMITH
ELECTRONICS**



See our other advertisements in this publication for address details, phone numbers, post and packing etc.

Shoparound

THIS PAGE is to assist readers in the continual search for components, kits and printed circuit boards for ETI projects. If you are looking for a particular component or project — check with our advertisers if it is not mentioned here.

ETI-330 car alarm

We understand that this project will be widely stocked as a kit. In Melbourne, try the following suppliers: All Electronic Components and Rod Irving Electronics. In Sydney: Electronic Agencies and Jaycar. Dick Smith Electronics will also be stocking this project, to replace our older unit, the ETI-084.

In addition, quite a few suppliers have indicated they will be stocking the pc board and will have the other components available off the shelf. In Melbourne, try Ellistronics, Magraths and Tasman Electronics. In Sydney, try Radio Despatch Service and Dave Ryall Electronics. West Australian readers should try Altronics in Perth.

If you're looking for automotive cable to wire the alarm into your vehicle, most motor accessory shops carry it so you shouldn't find it difficult to obtain.

The LM394H (IC1) was in short supply at the end of May, as we went to press, but the local National Semiconductor distributor, Semtech, advised us they were expecting stocks of the LM394C to arrive before the end of June, so constructors should be able to obtain this device by the time this issue goes on sale.

ETI-258 mini-drill controller

This project uses mostly off-the-shelf components and constructors should have little difficulty obtaining them. The electrolytic capacitor, C1, may be either 2200 μ or 2500 μ , so long as it's a pc-mounting type. The three-terminal regulator, IC1, may be either a 7805 or LM340T/5. The heatsink we attached to this IC was a type 342-1PP from the American AHAMtor range, sold here by Stewart Electronics, 44 Stafford St, Huntingdale 3166 Vic. It costs about \$1. Any similar heatsink that can dissipate a few watts should suffice — even a piece of aluminium sheet.

You *haven't got* a mini-drill but you've seen the project and think it's a good idea to get one? Well, mini-drills may be purchased from Dick Smith

stores, David Reid Electronics (Sydney), Radio Parts (Melbourne), Magraths (Melbourne), Altronics (Perth) and many hobby and craft suppliers.

Plugpacks suitable for powering this project are widely obtainable. The ac output types are generally rated at 12 Vac, 200 mA or 500 mA output (e.g. Dick Smith model M-9555). Ferguson Transformers market an ac output plugpack-style bell transformer (for doorbells, alarms, etc) rated at 8 Vac, 1 A, and this too would be suitable. If you discard the input rectifier (diodes D1 to D4) then the project can be powered from a 12 Vdc output plugpack rated to deliver 200 mA or more.

ETI-154 logic probe

This project uses parts which should be widely available, with the exception, perhaps, of the tiny seven-segment display the author used in his prototype. To fit inside the Ball Liner pen barrel as described, you'll need a display such as those used in pocket calculators. These are often available as 'surplus' items — try Pre-Pak Electronics or Sheridan Electronics. If you don't wish to cram the project into a pen barrel, then a probe housing such as the Jabel PH3 would probably suit you. These can be obtained with a clear plastic barrel so that the LED mode indicator display can be viewed through it. There is considerably more room inside these probe housings than in a pen barrel and a conventional seven-segment LED display may be easily fitted. Jabel probe housings are marketed by Watkin Wynne, 32 Falcon St, Crows Nest NSW 2065. (02)43-2107. Radio Despatch Service in Sydney stock them.

NEW! NEW! NEW!

Next month Sheridan Electronics returns to 'the fold' (pardon the pun) with an 8-page catalogue of goodies which you should find inserted in your issue of ETI. Sheridan specialise in components you'll usually find hard to get elsewhere, apart from stocking a range of the more common components. Check next month's issue for your catalogue to see what they have to offer.

Melbourne readers who live east of the metropolis will no doubt be pleased to learn that a new electronics store has opened in Dandenong. Robtronics is the name and you'll find it at 295 Thomas

St, Dandenong. The proprietor, Robert Kloestor, had always felt there was a need for an electronics store in the Dandenong area, so a few months ago he purchased a stock of surplus electronic components and also became a Dick Smith 'reseller'. Keen enthusiasts will find items such as surplus valves and radio equipment in the store, along with a range of Dick Smith kits and components. If you want to check if Robtronics stock a particular item you can phone Robert Kloester on 791-2900.

On this page back in our February issue, we announced the availability of the British ILP series of audio modules, which are sold here by Electromark of 40 Barry Ave, Mortdale NSW 2223. Electromark advise that the latest module in the series, a summing amplifier, is now available. Designated model HY7, this module is designed for audio mixing applications. Eight inputs are provided, each of which has unity voltage gain. Frequency response is quoted as 15 Hz to 50 kHz (+0, -3 dB) at 500 mV output and signal to noise ratio greater than 80 dB. Distortion is given as 0.005%, maximum output as 7 V RMS into a 2k load and current consumption as 5 mA from each supply rail (± 15 V). The module measures 45 x 50 x 20 mm (including the connector) and weighs 65 grams. Contact Electromark for further information. ●

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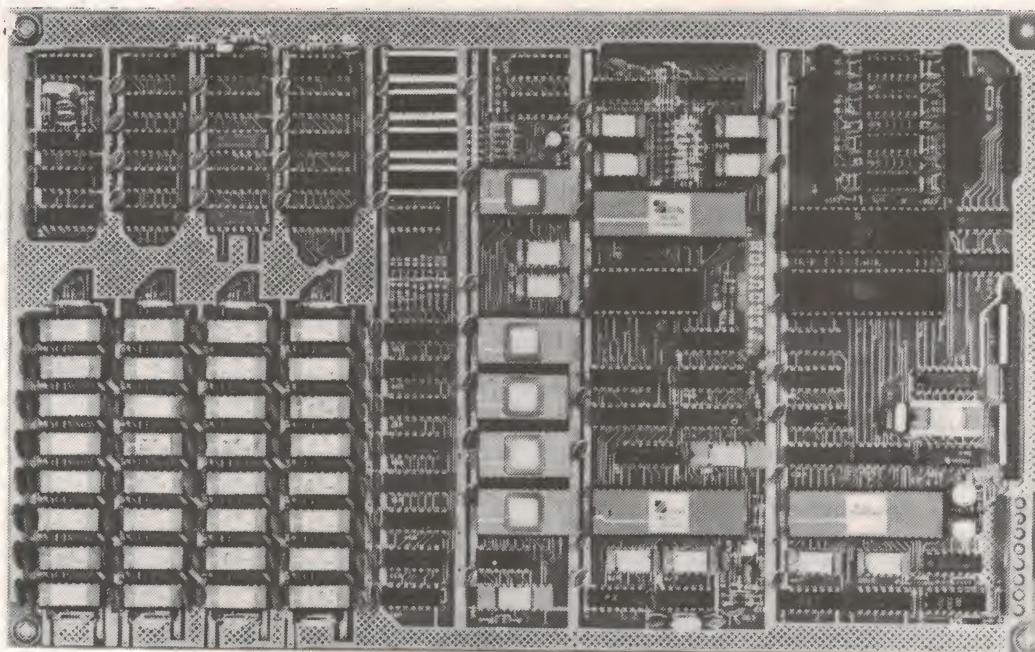
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Uses industry standard 4116 RAM'S. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERRUPTS. Fully buffered and runs 8080 software

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Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: **\$95**

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24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true.

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Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M* 2.2

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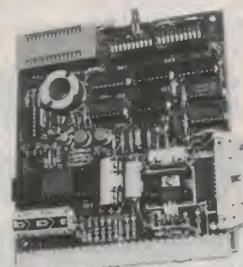
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Software — 2708 (NEP-3/8), 2516 (NEP-3/16)	\$24*
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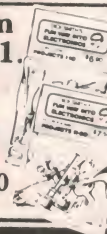
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COMMUNICATIONS



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A Course In Radio Fundamentals, by George Grammer, is recommended reading for anyone studying for their amateur licence, be it Novice, Limited or Full. In fact, it's a very good reference text for any enthusiastic hobbyist. The book has 26 chapters covering everything from the Electronic Field to RF Amplification. A variety of experiments are included along with problems and answers. The book has 180 pages and costs \$7.00.

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The ARRL Antenna Anthology and the ARRL Antenna Book must be the two best-known practical 'reference' works on the subject of antennas. The Antenna Anthology is a compilation of the best of recent HF antenna articles and theory

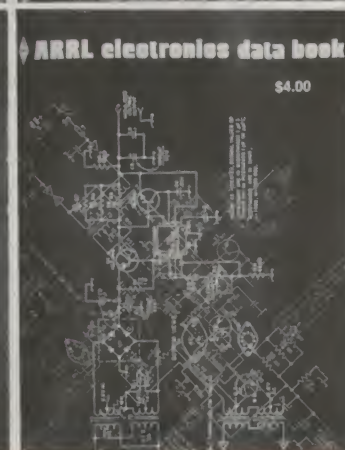
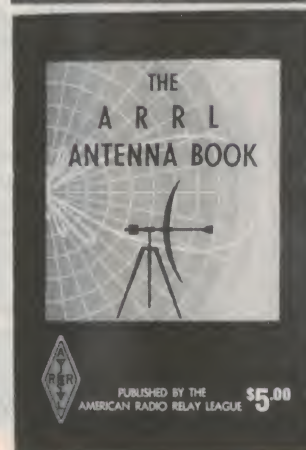
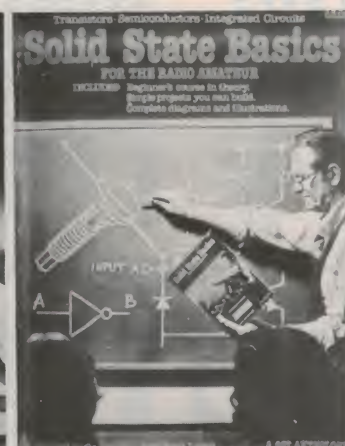
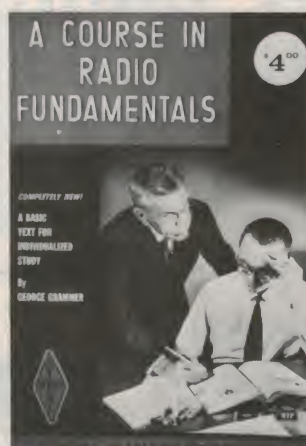
presentations from QST magazine. It runs to 152 pages and costs just \$7.00. The Antenna Book is a solid text covering everything from wave propagation to antenna construction and RF measurements. This updated edition of a famous text runs to 336 pages and costs \$8.75.

The ARRL Electronics Data Book is a must for every experimenter's shelf, workshop library or enthusiast's bench. Its 10 chapters cover maths aids and tables, time and frequency, transformers, LCR networks, filter designs, antennas, etc, and a useful potpourri of data. It's 128 pages long and only \$6.75.

The Basic Book of Ham Radio is just what it says. If you want to know what the hobby's all about, or want to let a budding enthusiast know, this book is just the thing. Only \$7.75.

The ARRL World Map is a modified equidistant azimuthal projection showing countries, call areas, time zones, ITU divisions, etc. This huge map would be a valuable addition to any shack. \$6.75.

Postage is \$1.35 for one to four items, \$2.70 for five items or more. You may order them from ETI Book Sales, 4th Floor, 15 Boundary St, Rushcutters Bay NSW 2011. You should allow up to four weeks for delivery.



Sky Ace receiver available again

GFS Electronic Imports of Melbourne recently announced that they now have stocks again of the airband receiver, Sky Ace Model R-517.

The Sky Ace is small and sturdily constructed, giving coverage of the airband from 108-136 MHz using both a main or fine tuning control, and has up to three crystal-locked channels.

This receiver is designed for use by both amateur and professional pilots, but could be just as useful to anyone interested in monitoring aircraft communications.

Price of the Sky Ace is \$109 plus \$4 postage; standard frequency crystals are \$8 each, with special frequency crystals at \$20 each.

Further information may be obtained from GFS Electronic Imports, 15 McKeon Rd, Mitcham Vic. 3132. (03)873-3939.



Digital storage RF spectrum analyser

Bringing digital storage capabilities to the most widely used frequency ranges in the RF spectrum, Tektronix recently introduced the 7L14 Spectrum Analyser.

The 7L14 will be of special importance to operators using the HF, VHF and UHF bands, and has been designed to meet the needs of user groups such as broadcast stations (AM, FM and TV), military communications, CATV companies, and utility companies (specifically firms and agencies that use two-way radio).

The 7L14 is claimed to have a longer lifetime and lower operating costs, resulting from the use of a standard P31 Phosphor CRT in place of the storage CRT.

The 7L14 provides frequency coverage from 10 kHz to 1800 MHz.

Other features include a built-in limiter to protect the first mixer; 70 dB on-screen dynamic range; spurious free; minus 130 dBm sensitivity, with 30 Hz resolution; CRT readout of control settings; four-to-one shape factor resolution filters; tracking generator and counter options; and a display mainframe compatible with more than 25 different 7000 Series plug-ins.

More information can be obtained from Tektronix Australia Pty Ltd, 80 Waterloo Rd, North Ryde NSW 2113. (02) 888-7066.

VIDEO TAPE RECORDER OWNERS VIDEO TAPE RECORDER BUYERS JOIN THE

Membership Privileges Include:

Free Catalogue

Video Tape Network members will receive a free catalogue which will include one of the largest selections of Video Tape Cassettes in Australia.

This huge range of films will include: New Hollywood releases, sports, education, adult entertainment, children's films, and a new range of special offerings on cassettes and important video events that will be exclusive to the Video Tape Network group and will not be available anywhere else in Australia. This catalogue will also offer a wide variety of accessories for your video tape recorder that are not presently widely available in Australia.

A regular update of this catalogue will be despatched to members which will include special offers in blank cassettes, new film releases and special equipment purchase offers in such items as large screen televisions and portable video tape recorder cameras — all at very special prices.

Free Newsletter

A Video Tape Network newsletter will be sent to members free on a regular basis to keep you informed of new product releases, technical tips for your video tape recorder, special product offers, government decisions which may affect you, information on such issues as satellite TV and the use of home computers with your video tape recorder and other Video Tape Network services as they become available.

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If you are looking for a particular movie title or have a general interest in a certain area, contact us and the Video Tape Network will do its best to help you find the video cassette you are looking for.



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A National Annual Convention will be held for members complete with guest speakers and demonstrations of the latest in electronic products for the home.

No Risk — No Obligations

Under no circumstances are you ever obligated to purchase any item; absolutely no product will ever be sent to you unless you specifically order it.

Special Offer — Act Now — Save \$20

As a limited offer for new members who pay \$10 now, the Video Tape Network will offer you:

1. One year's membership (normally \$20) and
2. A package of Tape Tracker Indexes which allow you to keep track of what is recorded on your

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Please accept me as a member at once.
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Address.....

Postcode.....

Phone No.....

Send to: **VIDEO TAPE NETWORK**
(a division of Video Corp of America Pty Ltd)

338 Queen Street
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Ph: (03) 329 7998

☐ I am not interested in joining VTN now but please add my name to your mailing list for future information.

COMPUTING TODAY

New computer magazine for non-experts

June saw the launch of a new computer magazine boasting that it's written in "... an amazing new language. English"!

Published by the Scientific Publishing Division of Modern Magazines (publishers of ETI), it is called 'COMDEC Business Computer Magazine'. The June issue is the 1981/82 Yearbook, which will be followed by regular issues throughout the year.

The magazine is written for people who have to make decisions about computers but who don't understand the difference between a floppy disk and a mini-floppy, ROM and RAM, byte and kilobyte.

The first issue contains a dozen articles on everything from 'Purchasing Your First Small Business Computer' through 'Approaching Word Processing: A Beginners' Guide', 'Computer Crime...', 'Negotiating A Computer Contract' to 'Office Applications For Graphics'.

In addition, Comdec contains a directory section listing major vendors of microcomputers, minicomputers, terminals, word processors, micrographics and specialists. Articles have been written by such industry luminaries as Roger Davis of Liveware, Trevor

Housley of Housley Computer Communications, Tim King of 3M's Micrographics Division and Kevin Fitzgerald, the Executive Director of the Computer Abuse Research Bureau at the Caulfield Institute of Technology.

The 1981/82 Yearbook runs to 180 pages and costs \$4.95, available at all newsagents.

Understanding and using computer graphics

This is the title of an extremely successful seminar, already held for several years in Europe and the US, which will be held in Sydney this year from July 15-17.

The seminar is designed to make the full usage and benefits of computer graphics known to both potential and current users. It covers an explanation of graphics, their use, justification, and systems; explains CRT, input devices, commercially available user stations, hard copy, software, applications

and evaluation techniques.

The seminar will also be held in Hong Kong from July 8-10 this year. For further information or to register, contact Frost & Sullivan Ltd, 104-112 Marylebone Lane, London W1M 5FU, England. (01)486-8377; telex 261671 (FANDS G).



Dicker Data supply Navy

Dicker Data Projects have successfully applied for a tender to supply the Navy with 17 Vector Graphics systems for use at the Naval College, Jervis Bay.

Fourteen of the Vector VIP word processing-like facilities, systems will be used to train young naval officers in programming. The other three will be used for administrative purposes, including a library catalogue system.

A 3030 system is being purchased for mass storage, incorporating a Winchester hard disk drive with a capacity of 32 megabytes.

The VIP systems have 64K of memory using the Z80A CPU. Two floppy disk drives will be used, giving a storage capacity of 630K.

The CP/M operating system is to be supplied with the machines, along with the RAID debugger and SCOPE, a full-screen editor with

word processing-like facilities, including global search and replace, block move and horizontal scrolling.

The tendered order was for \$110 000 and was scheduled for delivery in late April/early May this year.

Dicker Data Projects Pty Ltd, of 31 Cawarra Rd, Caringbah NSW, (02)525-4707, have 150 systems installed to date in such varied applications as the Western Australian Education Department, the CSIRO, universities and many different small businesses.

Vector products are available through a dealer network throughout Australia.



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Also:

Facilities management consulting.
Software and computer sales.
Computer data preparation.

DATASOUTH DS180 HIGH SPEED MATRIX PRINTER

The Datasouth DS180 is a dot-matrix serial impact printer designed for high performance at an economical price. Application flexibility and a long list of standard features make the DS180 an ideal device for small business systems, distributed communications networks and intelligent terminals.



Advanced single board computer is locally made

Two years of research and development have culminated in the release of an advanced single board micro featuring a 4 MHz Z80 CPU, 64K of RAM, four peripheral interface ports and a floppy disk controller, designed to serve as a stand-alone business or scientific computer.

Designed, developed and marketed by Advanced Digital Systems of Sydney, the SBC is designated the ADS8000 and has the capability of running all the popular high-level languages (BASIC, FORTRAN, COBOL, PASCAL, CBASIC and FORTH).

The ADS8000 is based on the Zilog Z80A microprocessor and operates at a clock rate of 4 MHz. Minimum instruction execution time is claimed to be 1 μ s. A monitor stored in a 2K EPROM performs the power-up system diagnostic tests and loads the disk operating system. 64K of 200 ns dynamic memory is built on board with a bank switching scheme. During normal operations, the monitor EPROM is switched out, thus leaving the full 64K of memory for program usage.

The floppy disk controller handles up to four single- or double-sided drives. It can be connected directly to any 8" (203 mm) drives produced by Shugart, Y-E Data,

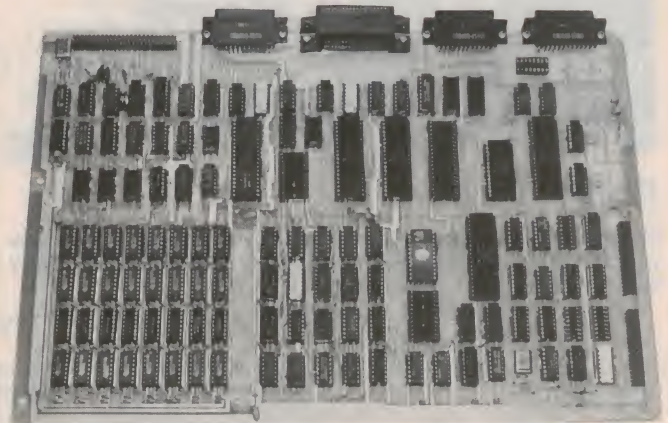
Remex or Siemens.

The controller supports the industrial standard IBM 3740 (FM) recording format. CP/M 2.2 Disk Operating System by Digital Research of America has been adapted to run on the ADS8000, and as well as the various languages, word processing and accounting packages are available.

Communications facilities in the ADS8000 consist of two RS232 serial ports and two parallel ports. The two RS232 ports can be used to connect various video terminals, modems, printers, graph plotters, paper tape readers or punches. Data transmission speed is programmable from 110 to 9600 baud.

Of the two parallel ports, the first is programmed to accept Centronic type printers, and the second, which has eight bidirectional data lines and two control lines, is available for general purpose interfacing.

The ADS8000 is specially designed for computer manufacturers and original equipment manufacturers (OEMs). It provides the



low-cost alternative to doing in-house circuit board design and manufacturing.

For further information contact the manufacturer, Advanced Digital Systems, 34-40 Central Ave, Manly NSW 2095. (02)977-6955.

Advanced Digital Systems will provide full technical support to OEMs who wish to incorporate the

THE Z80 — NAKED AT LAST?

Following the article on 'Uncovering the Z80' in our April issue we published a note from Stephen Dennis in June issue's Printout (page 97) about further undocumented instructions. However, one reader, Mr Peter A. Schmektschek, uncovered what may be either an omission or two in the original article and/or differences between his System 80 and the original author's TRS80. Here's what Mr Schmektschek found:

"In the article 'Uncovering the Z80' on page 88 (of the April issue) I feel the source listing of program 1, line 340 should read LD A,XL and not LD A,XH.

"Also, on page 89, the source listing of program 2, line 4050 appears to have two bytes missing: line 4050 should read: DATA 221,33,52,18,253,120,86,221,69,253,76,253,85,221,92,221,125,201

"The instruction in bold (line 330 in program 1) was missing and so test segment 1 failed though the others were successful (on my System 80 Mk 1).

"Incidentally, in line 4040, program 2, the data 19, . . . will now be correct."

Another reader, Tony Garland of Terrey Hills, NSW, found he had to make the following changes for the program to work on his TRS80:

ADD NEW LINE
5 CLEAR 500
(to overcome ?OS error in 3090).
Alter line 4040 to read
4040 DATA 17,52,13398,30738,4660,22136,LD1
(otherwise, in the READ statement line 80, J4 will try to read LD2 in DATA line 4070, which it cannot do).

Tony found segment LD1 in his system failed.

Z80 peripheral processor board

Memory Electronics recently announced details of the M80 Peripheral Processor Board, which executes Tiny BASIC (resident in ROM) and Z80 machine code.

The M80 sits on the serial or parallel port of any computer such as TRS80, Sorcerer, Apple, System 80, etc. Programs are downloaded into RAM from the host machine, or the M80 can stand alone with program in ROM.

The M80 is said to open up applications such as robots, message processors, alarm message generators, smart peripherals and controllers.

The M80 is configured with up to 2K RAM, a possible 4K ROM, a wire wrap area for addition of, for example, a UART, A/D converter, floppy disk controller, speech

processor, etc. 16 versatile, buffered I/O lines are available on the connector.

The M80 is small and fully documented. Software for editing, debugging and loading Tiny BASIC is also available, and Z80 code can of course be generated on your machine with a DDT or Assembler, or with the M80 monitor.

The M80 is priced at around \$100 plus monitor (\$32) or BASIC in ROMs (\$46).

Further information may be obtained from Memory Electronics, P.O. Box 322, Moorabbin Vic. (03)557-5394.



Pupils' PETs!

Commodore has prepared an advisory programme to show teachers how to use computers to help run their schools as well as to further their pupils' education.

Nigel Shepherd, head of Sydney's Commodore Information Centre, sees a major responsibility in preparing young people for computers in society.

The campaign offers a free \$1000 PET (Personal Electronic Translator) to every school that installs a bigger Commodore 3000 Series model. The big machine is for the school to use, for example in day-to-day business administration, charting students' academic history, balancing availability of classes against the number of pupils, etc. The PET would be for the students' use.

Commodore has a huge bank of specially written school programs on physics, maths, English, languages, numeracy skills and even on computers themselves, but the PETs are not just for teaching but for the children to experiment with, write their own programs on, analyse sports results, etc.

According to Nigel Shepherd, "When we first introduce a Commodore 3000 to a teacher, a common response is: 'What am I going to do with it?' Even maths and science teachers are often shy of it because they don't know enough

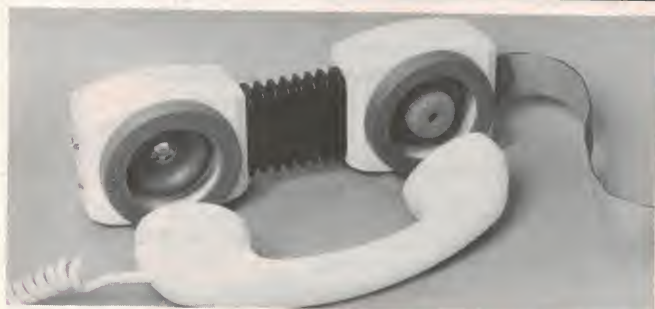
about computers to justify having one."

Mr. Shepherd also mentions a "psychological barrier" against computers in school, but stresses that personal teaching skills are still necessary to operate computer teaching successfully.

Commodore established a back-up service and maintenance facilities before starting operations in Australia in September 1980. This has paid dividends in acquiring business; as Nigel Shepherd says: "It's no good having a computer that has to be sent half-way round the world if any bugs get into it."

Commodore recently announced a profit in its first three months of operation, after writing off all setting-up costs in Australia, and expect a turnover in excess of \$200 million for this fiscal year. Its dealer network is now 60-strong, and figures for December and January showed sales of 300 PETs alone, regarded by Nigel Shepherd as an "unbeatable sales figure". In addition Commodore sold full business systems.

For further information telephone Di Palmer on (02)33-4225, or Nigel Shepherd on (02)437-6296.



Space-saving VDU from ADE

Anderson Digital Equipment recently announced a new VDU design, manufactured by the Teleray factory, which is believed to be the smallest and lightest 12-inch terminal in the industry.

The new 'L'-style display unit occupies just 12 x 13 inches of desk space, and weighs 18½ lb. With an optional wall-mount bracket, it may be tilted and swivelled to achieve optimum viewing angle, and, except for its detached keyboard, it occupies no desk space at all.

The L-style is initially available on the two fastest-moving Teleray models — the 10 and the 100. Model 10L is a single-page editor with user-programmable function memory; the 100L is a 132-column, VT100-compatible unit, with 'advanced video', bi-directional

peripheral port and user-programmable function memory. Both are completely modular, for quick and easy servicing by anyone, without tools.

The Model 10L is priced at \$1505 and the 100L at \$2095, and both will shortly be available through the A.D.E. network of branches and distributors in Australia, New Zealand and Papua New Guinea.

For further information, contact Anderson Digital Equipment Pty Ltd, 1 Expo Court, Mount Waverley Vic. 3149. (03)543-2077.

Buss allows MicroCon to work as slave

MicroPro Design recently released a new interface, the IEEE488 (HP-GP18) buss, for use with their MicroCon microprocessor system.

This buss allows the microprocessor in MicroCon to act as a slave to computer systems, so that it can control/monitor systems using the other interfaces available.

Computers such as the Commodore CBM and PET or Hewlett-Packard 9845 or 85 systems can be inexpensively interfaced to sensors, etc. The microprocessor in MicroCon can have its program loaded from the

host computer, allowing it to perform the control or data acquisition function independently of the operation being performed in the host. This can be particularly important in fast real-time applications.

For further information contact MicroPro Design Pty Ltd, P.O. Box 153, North Sydney NSW 2060. (02)438-1220.

Modem lets computers talk to each other

Dick Smith Electronics has just announced a new low-cost acoustic modem which allows digital data to be transmitted and received over the normal telephone network.

Transmitting at rates up to 300 baud, this new device makes it possible for computers and data terminals to communicate using standard telephones, and for computer/terminal owners to access remote data bases.

The new modem is said to be compatible with most telephone handsets worldwide, and is simply operated by dialling the required number and fitting the transmitter and receiver of the handset into the coupler's rubber-lined receptacle.

The coupler is designed for full duplex operation, so that data may

be transmitted and received simultaneously. It is also switchable between the 'answer' and 'originate' modes, so that communication between two units is just as easy as between one unit and a fixed 'answer' modem.

Power for the unit is normally provided by a standard 9 Vdc plug-pack, but provision is made for supply from the computer/terminal.

Designated by the catalogue number X-3270, the unit is priced at \$399, and was expected to be available from Dick Smith branches and resellers by April this year.

Digital cassette recording system

Memodyne Corporation of the USA have announced a new portable and compact RS232C compatible recording system.

The 2343CV is a self-contained instrument that accepts data at 110 and/or 300 baud, formats the data and records it on certified digital cassettes. The unit will also play back at 110 and 300 baud in addition to reading complete files continuously at 1200 baud. Teletype data from a 20 mil. current loop may also be recorded and read out.

The 2343CV features eight controls which may be operated by front panel switches or activated by negative action TTL or CMOS signals through a rear connector. These controls include Record, Hold, Playback, Off Load Forward, Rewind, Backspace and Step.

The 2343CV has a storage



capacity of 72 000 characters. It is 10½" wide x 12" deep x 7" high and weighs only 12 lb.

For further information please contact: Mr. Andrew Reid, Marketing Director, The Dindima Group Pty Ltd, P.O. Box 106, Vermont Vic. 3133.

Floppy disk system for Sorcerer IIs

Dick Smith Electronics now have available a self-contained add-on floppy disk subsystem (FDS) for the Sorcerer Mark II computer.

All disk controller and interface logic is included within the drive box, together with a power supply, so that the FDS plugs directly into the expansion socket on the rear of the Sorcerer and does not require the Sorcerer's S100 expansion unit.

The FDS's mini-floppy drive and controller take standard soft-sector diskettes and give 77 tracks of double density storage capacity. This gives a formatted data capacity of 308K bytes per disk. The controller within the FDS can also handle up to two add-on drives.

The FDS is claimed to provide double the usual data transfer rate: 250 000 bits per second instead of the more usual 125 000, which means that programs and data are loaded and saved in approximately

half the usual time.

The FDS comes complete with a version of CP/M that has been specifically designed by Exidy to suit the Sorcerer and FDS combination. Along with the CP/M comes a variety of utility software programs, including a Z80 assembler, a linking loader, a debug and an editor. Also provided is a comprehensive folder of user documentation covering hardware, installation, software functions and operating instructions.

Price of the Sorcerer Floppy Disk Subsystem is \$1190, and it will have the Dick Smith catalogue number of X-3220. It should be available from Dick Smith branches and resellers in all states from mid-May.

New 5 V only 64K RAM from Intel

Intel Corporation recently introduced the 2164, its first 64K dynamic RAM.

Designed with Intel's patented HMOS (high-performance MOS) process technology, the 5-volt-only 2164 is said to provide users with upward compatibility with Intel's future 256K RAMs.

The 2164 also allows users of Intel's current 2118 +5V 16K dynamic RAM to upgrade to a compatible product.

The 2164 is configured in a 64K x 1 bit organisation and is packaged

in the industry standard ceramic 16-pin DIP pinout.

Intel has also announced the introduction of a new board-level memory module for general purpose computer applications, which makes the 2164 available to designers at the system level.

For further details contact AJF Systems and Components, 310 Queen St, Melbourne Vic. 3000. (03)67-9306.

For Sorcerer Apprentices

It's only going to be a short one this month, unfortunately, but the following should be very useful for many enthusiasts.

Dear Editor,

The enclosed object code listing is a subroutine which can enlarge the characters displayed on the video screen by 16 times. This is particularly useful in a program where headlines or instructions are to be displayed in bigger than normal characters. Go into Monitor by typing `BYE` in BASIC, then enter the codes starting from `FD08` hex. After entering the codes, save on cassette by typing:

`'SA LARGE FD08 C8' <CR>`

Now try the instruction `'SE O=0' <CR>`

Wow! everything displayed is blown up sixteen times. To get back to normal size, type:

`'SE O=V' <CR>`

To call the subroutine in BASIC, use the following routine before and after each print statement where large display is required.

Subroutine to call LARGE character subroutine:

`1000 Z=256 * PEEK (-4095) + PEEK (-4096) - 47`

`1010 IF Z > 32767 THEN Z = Z - 65536`

`1020 POKE Z,0 : POKE Z+1,0 : RETURN`

Subroutine to get back to NORMAL size video:

`2000 POKE Z,27 : POKE Z+1,224 : RETURN`

For example, to print "SORCERER" in large prints:

`100 GOSUB 1000`

`110 PRINT "SORCERER"`

`120 GOSUB 2000`

`130 END`

Daniel Wong.

ENLARGER ROUTINE BY DANIEL WONG

ADDR	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
FFD0:	00	00	00	00	00	00	00	00	0F	0F	0F	0F	FF	FF	FF	FF
FFE0:	F0	F0	F0	F0	FF	FF	FF	FF	FF	FF	FF	FF	0F	0F	0F	0F
FFF0:	FF	FF	FF	FF	F0	F0	F0	F0	FF	FF	FF	FF	FF	FF	FF	FF
0000:	F5	FE	0C	28	26	FE	0D	28	22	FE	0A	28	28	FE	17	28
0010:	1F	FE	1A	28	20	FE	01	28	17	FE	13	28	13	FE	08	28
0020:	0A	FE	11	28	06	FE	20	30	11	F1	C9	CD	1B	E0	F1	C9
0030:	CDB1	00	F1	C9	CD	AF	00	F1	C9	FDE5	C5	D5	E5	6F		
0040:	26	00	11	00	F8	29	29	29	19	CD	A2	E1	FD	7E	6A	4F
0050:	FE	3D	38	08	3E	0D	CD	1B	E0	CD	AF	00	06	04	C5	56
0060:	23	5E	06	04	E5	C5	C5	01	00	00	7A	07	CB	11	07	CB
0070:	11	57	7B	07	CB	11	07	CB	11	5F	21	B9	00	09	7E	CD
0080:	1B	E0	C1	10	E1	3E	0A	CD	1B	E0	C1	79	06	04	FE	3C
0090:	20	02	06	03	3E	01	CDB3	00	E1	23	C1	10	C0	3E	13	
00A0:	CDB1	00	3E	17	CDB1	00	E1	D1	C1	FD	E1	F1	C9	3E		
00B0:	0A	06	04	CD	1B	E0	10	FB	C9	20	95	96	AA	A0	A8	A6
00C0:	FB	A1	A5	A7	FC	A9	FD	FE	FF							

Thanks Daniel, I can think of hundreds of uses for this routine. Several of my friends saw this routine working towards the end of last year and were most frustrated when I told them they'd have to wait for its publication in ETI. Little did I know that they would hassle me for such a long time about it.

Thanks for your contribution to this column and, keep up the good work.

A.P.F. Fry

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PRICE: (INCLUDES SALES TAX)	\$1417.35	\$1594.00

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— And remember — only a small fraction of the CPM Software on 8" Media is available on any given 5" system.



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In the world of personal computers there is just one that is known as the best: the PET

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The Commodore PET has become the standard for the Personal Computer Industry.

The Pet is completely integrated, with the processor, memory, keyboard and visual display unit contained within a robust housing, allowing easy transportation with no interconnecting cables necessary. In order to retrieve and save your data and programs, a storage device is used which operates like a cassette recorder, with your information recorded reliably on standard cassettes. The PET has 16k bytes of RAM. Optional equipment permits expansion to 32k. Also, it has 14k bytes of ROM.

The Pet communicates in BASIC—the easiest computer language. Easy to learn and easy to use, BASIC has now become the standard for personal computers, with literally thousands of programmes available. The PET is also programmable in machine language, allowing more efficient use of the system.

The full-size keyboard is capable of producing letters, numbers and graphic symbols. Upper and lower case is standard. Characters appear

on the screen in a pleasant green colour designed to reduce eye fatigue and may be displayed in normal or reverse print.

PET's IEEE-488 Bus—just like H.P.'s mini and full size computers—permits direct connection to over 200 pieces of compatible equipment such as counters, timers, spectrum analysers, digital voltmeters and printer plotters from H.P., Philips, Fluke, Textronix and others.

The full range of Commodore Disk Drives and Printers are plug-compatible with the PET and a comprehensive range of cassette and disk based programmes are available through the extensive network of Commodore Dealers.

APPLICATIONS

The Commodore PET is a creature of many faces. Its applications are limited only by the user's imagination.

The future of the PET is virtually unlimited; its present capabilities are already many and impressive. As a personal computer, the PET can teach languages and mathematics; play games; create graphic designs; store meal recipes and change

number of portions; maintain budgets, personal records and checkbooks; operate appliances and temperature controls.

As a management tool, it delivers the information the executive needs, in the form he can use, and available to him alone. Trend analyses charts and graphs can be almost instantly available.

The professional may use the PET for maintaining appointment schedules, recording income and expenditures and filing all the specialized information and forms he may need to make his work more efficient—from medical records for a doctor to income tax computations for an accountant.

The engineer, mathematician, physicist, has a tool far superior to the very best programmable calculators yet developed... at a cost that is comparable...and with almost infinitely greater versatility.

And the businessman has a computer that can maintain inventories, keep payroll records, operate accounts payable and receivables, issue cheques and handle correspondence.

Commodore PET 4016 Computer Technical Specifications.

Computer/Memory

Read/Write Memory (RAM) 16K bytes available to the user.
Read Only Memory (ROM) 14K bytes in total, divided into:
8K BASIC interpreter available immediately you turn on your PET.
5K Operating System
1K Test Routine

The 6502 micro-processor chip makes the PET one of the fastest and most flexible BASIC systems. Significant features of Commodore BASIC are:

- 960 simple variables
- 960 integers
- 960 string variables
- 960 multi-dimensional array fields for the above 3 types of variables
- Up to 80 characters per program line with several statements per line
- Upper/Lower case characters and graphics capability
- Built in clock
- 9-digit floating point binary arithmetic
- True random number generator
- Supports multiple languages; machine language accessibility

Keyboard

74-Key professional keyboard.
Separate calculator/numeric pad.

Upper-case alphabetical characters with shift key to give 64 graphics characters.
Can be set for lower case and shifted upper case characters.

Screen

40 characters wide by 25 lines (1000 characters in 8 × 8 dot matrix).
23 cm screen phosphor screen.
Brightness control.
64 ASCII plus 64 graphics characters.
Blinking cursor with full cursor control, including programmable control.

Screen editing capabilities

Full cursor control (up, down, left, right).
Character insert and delete.
Reverse character field.
Overstriking.

Return key sends the entire line to the CPU regardless of cursor position.

Input/Output

8 bit parallel input/output port.
IEEE-488 Bus (HP-IB and IEC Bus) allows up to 12 other peripherals to be connected.
Two cassette ports.
Video signals for additional displays.
Serial output port.

Technical Data

Dimensions: Height 355 mm (14"), Width 419 mm (16.5"), Depth 185 mm (18.5"). Shipping Weight 20.9 kg (46 lbs).
Power requirements 240V ± 10%, Frequency 50 Hz, Power 100 Watts.

Commodore BASIC

APPEND	GOSUB..RETURN	STOP	SPC
BACKUP	IF..THEN	SYS	LEFT\$
CLOSE	INPUT	VERIFY	RIGHT\$
CLR	INPUT *	WAIT	MID\$
CMD	LET		CHR\$
COLLECT	LIST	SGN	ASC
CONCAT	LOAD	INT	LEN
CONT	NEW	ABS	VAL
COPY	ON..GOSUB	SQR	STR\$
DATA	OPEN	SIN	TI
	POKE	COS	TI\$
DEF/FN	PRWT	TAN	ST
DIM	READ	ATN	DS
DIRECTORY	RECORD	LOG	DS\$
DLOAD	REM	EXP	+
DOPEN	RENAME	AND	—
DSAVE	RESTORE	OR	*
END	RUN	NOT	/
FOR/NEXT	SAVE	TAB	↑
GET	SCRATCH	POS	π

Commodore

microcomputers

And you thought your System 80 was just for playing games...

THESE PROGRAMS
WILL ALSO RUN ON A
16K TRS-80 MODEL II

Most people think the same way. Personal computers – ho hum. Great for playing 'Space Invaders' . . . but what else can you do with them?

How would you like to do your 1981 Income Tax return by computer?

AUSTRALIAN INCOME TAX, 1981

YES! You can now use your personal computer to accurately and properly complete your personal income tax return! 'Austax 81' goes through each vital step of the tax form, making sure you don't miss anything! Calculations are done for you – automatically – and you can add, delete or change any entry at any time: the program automatically adjusts all the figures to suit! As far as we know, this is the ONLY program available for the 1981 income tax form, written specifically for a personal computer!

Program suitable for form 'S' available June; program for 'A' form available July.
'AUSTAX 81' Cat X-3762 \$29.95

TYPING TUTOR

With our new 'Typing Tutor' program, you can learn to touch type in less than 8 hours! The computer is your teacher: it will tell you if you are making errors; even concentrate on the keys that are giving you problems! And it's so much cheaper than doing a typing course!

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Catalogue your stamp collection. Or your butterflies. Or recipes. Or even keep your club's membership records in order!

Dick's brand new 'Datfile' is an all-purpose data storage and processing program. You can store virtually anything you can write down in 'Datfile' – and then add to it. Delete it. Modify it. Sort it. Process it. Extract it or portions of it. In fact, you can use 'Datfile' to process information in just about any way you can imagine. Disk based.

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You've always regretted stopping those piano lessons! Now here's your opportunity to learn to read music – even though you can't play a note! It will teach you all the basics – from note recognition through to tempo.

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76 USEFUL PROGRAMS

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'COMMON PROGRAMS' Cat X-3665 \$19.50

AND FOR THE KIDS . . .

A set of three programs designed to help them learn. They learn faster because learning becomes FUN! Take your choice of maths oriented, spelling or word usage programs. They've all been written exclusively for Dick Smith.

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FOR MORE DETAILED INFORMATION: Ask for a free data sheet at any Dick Smith store, re-seller or the Mail Order Centre.

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NOW
\$695**

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It is over \$250 cheaper than a similar TRS-80 – and offers more features!

Features like a built-in cassette deck & power supply. 2 cassette controls instead of 1. S-100 bus compatibility. Built-in video modulator (use with any standard TV set!)

Want to know more about the amazing System 80? Ask for free comparison & information data: available at your nearest Dick Smith store, Mail Order Centre or authorised re-seller.

DICK SMITH ELECTRONICS

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AVAILABLE TO APP-
ROVED CUSTOMERS

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MMSFORTH is a powerful implementation of the popular FORTH programming language, designed for both professional and hobbyist use on System 80 & TRS-80 computers. Users can expand FORTH into virtually their own custom programming language. It comes on diskette complete with its own disk operating system, itself written in FORTH.

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Forth has a compiled code plus VIRTUAL MEMORY which makes your RAM act longer!
- ★ **Get more instructions . . .**
Add YOUR commands to its large instruction set! Far more complete than most other Forths: single and double precision, arrays, string handling and more!
- ★ **Get more ease . . .**
Forth gives you an excellent full screen editor, structured & modular programming. It is optimised for your System 80 (or TRS-80) with keyboard repeats, upper/lower case display driver, single & double width graphics, etc.
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Cat X-3668

\$85⁰⁰

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Thanks to fast animation and accurate representation of flight, the non-pilot can now learn basic flight control, including take-off & landing!

And experienced pilots will quickly recognise how thoroughly they can explore the aircraft's characteristics: without risk!

Computer and aviation experts call this program a marvel of modern technology: you'll call it fantastic! Once you've acquired flight proficiency, you can engage in the exciting British Ace 3-D Aerial Battle Game included in the package.

BASIC PLUS

ZBASIC, SIMUTEK'S BASIC COMPILER

Now you can have the best of both worlds . . . the ease of programming in BASIC, with the speed of machine language.

And your programs become VERY difficult to pirate!

Simutek's ZBASIC is what you need.

ZBASIC is an interactive compiler. This means it is resident while you write BASIC programs. You may compile your program and run or save it, in machine language form, without destroying your original BASIC version. In fact, jumping back and forth between your compiled code and the BASIC original is one of its best features.

The ZBASIC compiler allows saving your compiled programs to disk. Programs may then be loaded as a /CMD file from DOS. This makes it extremely hard for others to 'pirate' your programs.

And Simutek, the manufacturer, makes no royalty charge on programs that are compiled with ZBASIC—unlike some other companies which charge you up to \$200 a year!

Some of the BASIC commands supported by ZBASIC:

FOR	NEXT	STEP	IF	THEN	ELSE	PEEK	ON GOTO
SET	RESET	POINT	CHR\$	RANDOM	RND	POKE	ON GOSUB
DATA	READ	RESTORE	END	GOTO	GOSUB	CLS	
PRINT	LPRINT	PRINT#	USR	SGN	INT	ABS	
SQR	LEN	ASC	VAL				
INT, MATH — + * / AND OR SQR							

Why use a complicated 'Assembler' to write machine language programs when you can write them in ZBASIC?

\$140⁰⁰

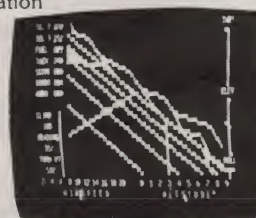
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Features:

- 3-frame per second flicker free animation
- Out-of-cockpit view of flight
- Constant feedback cassette loader

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Cat X-3684



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STORE FOR A FULL PROGRAM LIST!**





Touch typing tutor

The ability to touch type is one which few amateur programmers possess, but one which can be very useful, especially when typing in a long program from a printed listing.

Malcolm Banthorpe

THE PROGRAM presented here was developed for an Ohio Superboard as a means of using the computer itself (via its VDU display) to train the user to associate a specific finger position with a specific alphanumeric character. It can be successfully adapted for use on a UK 101.

Program description

The bulk of the program (lines 105-275) is used to generate a graphic representation of a keyboard. All alpha and numeric keys are shown but control, shift and punctuation keys are not included. The next section of the program (lines 280-315) is used to randomly select a single character and blank its corresponding key as depicted on the screen. This remains blank until the user hits the same key on the keyboard. If an incorrect key is struck then the character on the correct key is momen-

tarily flashed on the screen.

Throughout the exercise the user should keep his/her eyes on the screen and not look at the keyboard. In this way the brain should gradually come to associate a given finger movement with a particular character. For preliminary information concerning which finger should be used for which key and the correct position of the hands, the user should consult one of the many available books on typing.

Enhancements

The program as presented is very basic and there is considerable scope for expanding its teaching aspect. For instance, instead of choosing a random sequence of characters it would be a simple matter to offer instead sequences which would spell out coherent sentences, either of the quick brown dog variety or preferably an interesting

anecdote or joke previously unknown to the learner. This would make learning more enjoyable and provide a positive reinforcement to hitting the right keys. Another possibility would be, after some initial practice, to bias the selection of characters towards those which have been most frequently mis-keyed. These and other modifications are left to the ingenuity of the reader.

As mentioned above, it is possible to convert the program to run on a UK 101, which has a similar set of graphic characters to the Superboard but which has a different screen format. Details of the changes required are not given here as most of the POKE addresses need to be changed. However, any interested UK 101 user who is familiar with its graphics system will find that by running the program as presented, the resultant display will suggest the changes required.

Program listing

```

100 REM TOUCH TYPING
105 FOR X=0 TO 29:PRINT:NEXT
110 P=53478:POKE 11,34:POKE 12,2
115 FOR X=546 TO 552:READ C:POKE X,C:NEXT
120 POKE P,221:Q=P+1
125 FOR X=1 TO 9:GOSUB 340:NEXT
130 POKE Q,148:POKE Q+1,222
135 P=P+32
140 POKE P,149:Q=P+1
145 FOR X=1 TO 9:POKE Q,X+48:POKE Q+1,149:
    Q=Q+2:NEXT
150 POKE Q,48:POKE Q+1,149
155 P=P+32
160 POKE P,220:Q=P+1
165 FOR X=1 TO 9:GOSUB 345:NEXT
170 POKE Q,217:POKE Q+1,215:POKE Q+2,222
175 P=P+33
180 POKE P,149:Q=P+1
185 FOR X=1 TO 10:GOSUB 350:NEXT
190 P=P+32
195 POKE P,220:Q=P+1
200 FOR X=1 TO 9:GOSUB 345:NEXT
205 POKE Q,217:POKE Q+1,223
210 P=P+33
215 POKE P,149:Q=P+1
220 FOR X=1 TO 9:GOSUB 350:NEXT
225 P=P+32
230 POKE P,220:Q=P+1
235 FOR X=1 TO 8:GOSUB 345:NEXT
240 POKE Q,148:POKE Q+1,223
245 P=P+33
250 POKE P,149:Q=P+1
255 FOR X=1 TO 7:GOSUB 350:NEXT
260 P=P+32
265 POKE P,220:Q=P+1
270 FOR X=1 TO 6:POKE Q,148:POKE Q+1,215:
    Q=Q+2:NEXT
275 POKE Q,148:POKE Q+1,223
280 C=INT(RND(1)*43+48)
285 IF C.>57 AND C.<65 THEN 280
290 P=53510
295 Q=P
300 IF PEEK(Q)=C THEN 315
305 Q=Q+1:IF Q-P<21 THEN 300
310 P=P+65:GOTO 295
315 POKE Q,32
320 X=USR(X)
325 IF PEEK(640)=C THEN POKE Q,161:GOSUB 355 :
    :POKE Q,C:POKE 280,0:GOTO 280
330 GOSUB 355 :POKE Q,C:GOSUB 355 :GOTO 315
335 END
340 POKE Q,148:POKE Q+1,217:Q=Q+2:RETURN
345 POKE Q,217:POKE Q+1,215:Q=Q+2:RETURN
350 READ A$:POKE Q,ASC(A$):POKE Q+1,149:
    Q=Q+2:RETURN
355 FOR X=0 TO 100:NEXT:RETURN
360 DATA 32,0,253,141,128,2,96
365 DATA Q,W,E,R,T,U,I,O,P,A,S,D,F,G,H,I,J,K,
    L,Z,X,C,V,B,N,M

```

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How good is it? - This part of our advertisement was typeset using an ET-121 driven by a TRS-80. Write and ask for full details.

We have a wide range of Australian software available. Send for a free catalogue

Dick Smith's alternative — the System 80 (designed for Australia)

The System 80 from Dick Smith Electronics has recently been released in a Mark II version, and seems to be settling down to a position amongst the top sellers in the 'middle range' home computer market. We thought it about time that we took a closer look. Phil Cohen investigates.

Phil Cohen



THE SYSTEM 80, as most readers well know by now, is Dick Smith Electronics' answer to the Tandy TRS-80. Early advertising for the DSE machine carried price breakdowns for equivalent systems from both Tandy and DSE, and the System 80 is claimed to be software-compatible with the TRS-80.

Tandy is a very large organisation indeed. Having started in the US as, I believe, a leatherwork and homecraft shopping chain, they have grown to become one of the major forces in hobby electronics worldwide.

As with many of his 'exclusive' products, the DICK SMITH label carries a tag saying 'Designed for Australia'. It's interesting that this self-

same computer is marketed overseas as the 'Video Genie'. So much for the tag line.

First impressions

The System 80 comes in a sturdy plastic case with 'wooden' end cheeks (plastic, actually). The keyboard has a nice 'solid' feel to it — not quite the best I've come across on a computer, but far from being the worst.

A cassette mechanism is built in — an unusual feature. Most hobby computers these days seem to be going for an external unit — which cuts down on the cost, as the user may well have one already when he buys the computer.

The only other machine I can think of

that has a built-in cassette is the 'old' PET from Commodore — I say 'old', because the latest version of the machine has dropped the cassette mechanism in favour of a larger keyboard.

The bottom of the System 80 holds an interesting label — it says "BASIC INTERPRETER COPYRIGHT BY MICROSOFT, 1980 ...". This indicates that the machine runs the now-standard Microsoft Z-80 BASIC interpreter — well tried and tested, and with plenty of software available for it. No cost-cutting there.

The back of the case was a bit of a surprise. I had expected the enormous gold-plated edge connection usually found on this sort of machine. There is a ▶

connector — but smaller than most, and hidden behind a removable cover.

I found something extra, however — a couple of DIN audio sockets, more usually found on cassette recorders.

One is, in fact, for a second cassette recorder — the other is for the connection of a video monitor. It is unusual to use an audio connector of this type to carry video-frequency signals. Presumably, the amount of high-frequency interference radiated is within acceptable limits. This could be the start of a move towards the use of this kind of connector (which is, pin for pin, probably cheaper than the alternatives) for this application.

The power supply of the System 80 seems to be an integral unit — the mains switch, fuse and cable entry are all in one panel at the back of the machine, and this is part of an enclosed box within the main case of the computer.

Controls and indicators

Starting at the front of the machine, the keyboard has all the usual typewriter keys, plus computer-oriented ones. A loose sheet which comes with the manuals points out that the 'NEW LINE' key on the System 80 is identical in function to the 'ENTER' key of the TRS-80. There are a couple of other minor variations between the two keyboards, and this is due presumably to DSE using an off-the-shelf keyboard unit, and consequently not being able to match the other machine totally.

A LED at the top left of the keyboard indicates that the machine is switched on.

Two buttons above the main part of the keyboard provide functions connected with the cassette operation and the video output. Leaving the video one for the moment, the 'F1' button provides a function which has been much called-for by TRS-80 users: the cassette recorder motor in both machines is software-controlled. It turns on when the computer encounters an instruction to read from or write to cassette, and turns off when the reading or writing is finished.

Unfortunately, the user quite often wants to use the fast-forward or fast-rewind facilities of the cassette independently of the computer — perhaps even while the computer is doing something else. To accomplish this, early TRS-80 users (I believe that add-on devices now on the market obviate the problem) had to unplug the remote control jack from their cassette recorders, thus returning the motor of the recorder to manual control.

The 'F1' button of the System 80 overrides the software control of the

cassette, turning the motor on no matter what the state of the software.

The cassette mechanism has the usual controls, along with a counter (very useful for finding programs on a long tape — especially since the usual method of recording a spoken message before each program is not possible in this configuration).

A level indicator sited above the cassette mechanism, and a level control beside it, allow the user to set the level of the cassette output to suit the computer. This is necessary because in transferring programs (or data) from one machine to another, variations in recorded level can cause problems. Presumably the first System 80s had this sort of trouble — the meter and control appear only on the Mark II version.

A LED beside the cassette mechanism shows when the cassette motor is on — this is useful for spotting the end of a program which is currently loading.

The back of the computer holds the two DIN sockets I mentioned earlier — one for a second cassette and the other for a video monitor.

Two cables exit the machine at the back. One is for mains, the other for a TV set. The System 80 is unique as far as I know, in that it has outputs for both a video monitor *and* a normal domestic TV set. Cable bollards keep the TV connection neatly coiled if it is not used.

Two buttons stick out of the back of the machine — one is a RESET button, in case the user gets into trouble that even the BREAK key on the keyboard won't resolve.

The other button is called 'VIDEO CUT'. What it does is to change the screen width from 64 characters to 32 characters. This means that the right-hand side of the output becomes invisible (i.e. it disappears off the edge of the screen). The PAGE button just above the main keyboard allows the user to see the right-hand half — successive operations of the PAGE button switch the screen between left and right hand halves of the output.

The advantage of having 32 characters per line is, of course, clarity. I suspect that the idea was to allow the user to select the 32-character option while he was entering programs (program lines are usually fairly short, and don't fall off the edge of a 32-character wide screen).

Personally, I disliked using the 32-character format, as I was never 100% sure what I was missing off the edge of the screen — but that is just a personal view, and in any case you don't *have* to use it.

And that's it — the System 80 is the bare minimum when it comes to fiddly connectors and option switches.

Internals

The memory map for the System 80 is shown in Figure 1. There's nothing unusual about it, except perhaps that the user RAM starts at 4000.

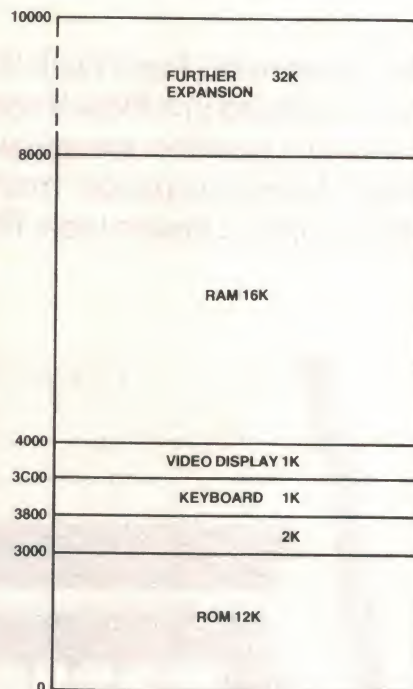


Figure 1. Memory map of the System 80.

In some machines, the operating system is arranged so that the user RAM begins at address 0 for simplicity of software writing. But this is a minor problem.

The total addressing space (with maximum expansion) is 64K — that's the limit set by the Z-80 microprocessor in its basic configuration, of which 48K is available as RAM. The standard configuration (i.e. without add-ons) has 16K of RAM.

There's really not a great deal more that I can say about the inside of the System 80 from the hardware point of view, as the documentation that came with it did not include any sort of circuit diagram — not even a block diagram. While on the one hand this is not necessary for the average user, who would tend to regard the machine as a 'black box', it's useful for the small percentage who might want to expand the system from the inside at a later date (after the warranty has run out).

The manual does give the pin assignments for the expansion connector on the back of the System 80. These are, basically, those Z-80 signals which are necessary for the correct operation of an S-100 buss system.

Dick Smith Electronics is already marketing an S-100 expansion box for the System 80, and they obviously had it in mind when they designated the pins of the System 80 expansion connector.

As far as the software goes, there's not much I can say on that score either — the BASIC system offered in the System 80 is a standard Microsoft BASIC interpreter with perhaps a few augmentations not found on some other machines. I was unable to check out the 'software compatible with Tandy TRS-80' claim.

For those who have not come across this type of BASIC system before, I have included a quick list of its more interesting capabilities below.

ACTIVE COMMANDS: i.e. those which are available to the user as soon as the machine is turned on, and which are not usually used within a program: **AUTO:** causes the computer to generate line numbers automatically during program entry, so that a program can be entered more quickly.

CLOAD: loads a program from cassette into the machine's memory.

CLOAD? re-reads a recently-recorded program from cassette and checks it against the memory contents to make sure that the recording is error-free.

CSAVE: records a program onto cassette.

EDIT: allows the user to change parts of a line of program without the need to re-enter the entire line. A number of special editing commands are in force while this is done.

SYSTEM: causes the machine to go into 'monitor' mode, in which the user can load or save machine code programs on tape, run or modify those programs, etc.

TRON, TROFF: turn on and off the 'trace' facility, which lists on the screen the line numbers that a program is going through *while it is running* — so if it is stuck in an 'endless' loop, the user can spot what is happening.

PROGRAM STATEMENT

COMMANDS: i.e. those used in the body of a program:

PRINT@: causes the computer, rather than just PRINTing something on the next available line of the screen, to start it at a particular point. This is very useful for graphs, etc.

PRINT USING: allows the user to specify the format of the numeric data to be printed. For example, a number can be output with two digits after the point, and with commas inserted in the appropriate places before the point.

PRINT #: puts data onto cassette, rather than onto the screen. I suspect that, with the addition of an S-100

expansion and a disk drive, the same command will be used to send data to the disk.

DEFINT, DEFSNG, DEFDBL, DEFSTR: cause a list of variable names to be treated as string, integer, etc. (i.e. without the need for \$, % or $\frac{\pi}{2}$ symbols). For example, DEFINT A-D will cause all variables starting with A, B, C, or D to be treated as integers.

ON ERROR GOTO: means that, rather than just giving an error message and stopping, the program can be made to jump to a particular line number when something goes wrong (e.g. division by zero, etc). This means that the program can give a listing of the current values of all of the variables as its 'dying gasp' — useful in debugging!

RESUME: in conjunction with ON ERROR GOTO means that the error can be ignored altogether. RESUME sends the program back to a particular line, forgetting that an error even occurred.

SET, RESET: allow the user to turn on or off a particular point on the screen (which is taken to be made up of 47 by 127 points for the purposes of these commands). This means that graphs can be put on the screen a point at a time.

POINT: allows the program to find out whether a particular 'point' (see previous command) is on or off.

Variable types

The types of variables supported by the System 80 are as follows:

INTEGER: within the range -32769 and +32769.

SINGLE PRECISION: a floating-point number with six significant digits and a power of ten from -38 to +38.

DOUBLE PRECISION: a floating-point number with sixteen significant digits and a power of ten from -38 to +38.

STRING: a sequence of characters up to 255 in length.



One of the 'cute' accessories available is this 'Sound Off' package, which provides music and sound effects for the System 80.

ARRAYS: of any of the above types of variables — with any number of dimensions.

And lastly ...

The System 80 is not a 'cost-is-no-object' machine — but then, it was never intended to be. Some of the corners that have been cut to bring a machine in at this price are annoying — the manuals could have been better, and there is no [key (you have to use the ESC key instead) — but none of these cut corners are fatal.

The value of the machine can only be measured against the use for which it is designed — for the home user who wants to learn about programming, and who perhaps has some minor software applications in or around the home, office or small business.

The System 80 would not stand up to a 'harsh' environment (e.g. being used as a word processor on a shift basis) — but then, that's not what it's for.

All things considered, I *would* recommend the System 80 to anyone who wanted to take up programming as a hobby. ●

SYSTEM 80 — GENERAL SPECIFICATIONS

RAM	4K or 16K
Keyboard	51-key ASCII
VDU format	64 character x 16 lines or 32 double-width characters per line.
Storage	cassette included plus provision to connect an extra cassette. Level meter and level control included.
Expansion	via 48-pin socket.
Video out	direct video out plus on-board video modulator (Ch. 1. output)
CPU	Zilog Z80, 1.7 MHz clock.
Language	12K Microsoft BASIC
Features	compatible with Level II TRS-80; memory expandable to 48K with S-100 expansion unit; expansion units available — parallel printer interface, voice box, S-100 expansion unit, S-100 RAM card, extra cassette deck, TV set monitor.
Price	\$695 with 4K memory \$750 with 16K memory

Review unit supplied by Dick Smith Electronics, North Ryde NSW. Supplied with Users' Manual, BASIC Manual and Programming For Beginners books.

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Cassette interface, 300 Baud Kansas City standard, so you can swap programs, ask your dealer how to double the speed!

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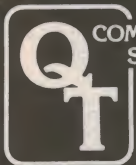
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Bare Board \$ 60.00
A&T \$295.00

RAM+ 65

• S-100, 16K x 8 bit static RAM • 2 or 4MHz • Uses 2114L (300NS) CHIP • Addressable in 4K steps • Memory protection in 1K increments, from bottom board address up or top down • May deactivate up to six 1K segments of board to create "holes" for other devices • DIP switch selectable wait states • Phantom line DIP switch • Features bank selection by I/O instruction using any one of 256 DIP switch-selectable codes - allows up to 256 software-controlled memory banks.
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~~Spelguard~~

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Spellguard — every proofreader's dream!

Spellguard is a software system for use with microcomputers that proofreads a text file typed into a word processor or text editor. Elaine Ray reviewed it for us, and not only did she find it an excellently organised and beautifully documented system, the copy she turned in having used it required the minimum of corrections!

Elaine M. Ray.

SPELLGUARD makes me realise how far the microcomputing world has come since the era when Altair was number one and if you wanted a computer you built your own system. In those days, if a program worked at all, you were happy. Now we have software that works as well as mainframe programs. Spellguard is an example of the new standard — fully professional micro-computer software.

Spellguard was reviewed using an IMS International Series 8000 using 96 M hard disk system and twin double-sided double density disks. This program will also run under MP/M.

What Spellguard does

Spellguard's purpose is to help users find spelling and typographical errors. It is meant to work in conjunction with a word processor or text editor, but it operates independently on the text file itself. It should therefore be generally compatible with almost any other program which operates under CP/M to create an ASCII text file. I know that there are no problems with the Word-Star Word Processor or WordMaster Text Editor.

To describe the operation of this remarkable system, assume that you've created a CP/M text file using a word processor or text editor. Next you type "SP <filename>", and CP/M loads and executes Spellguard, which in turn starts proofreading the specified text file. Should you wish not to proofread first off, you need only type in "SP". The Master Menu will prompt you to type the name of the file you want proofread, and the program assumes that every series of letters between spaces, numbers or special characters in the file is a "word" and compares it to the dictionary file. For example, "customer6" in a file causes "customer" to be compared to the dictionary, but "customer#six" causes both "customer" and "six" to be compared.

Each word is then determined to be a match or mismatch with the currently selected dictionary entry. If it is a match, nothing happens; if, however, it is a mismatch, it is remembered by the program for review after the proofreading has been completed. You can then review the mismatches one word at a time or all at once and do one of three things with them. If the word is a typographical error such as

"threethings" or if it is a spelling error such as "compatable" you can change the last character of the word to a predetermined special character in the original text file. (The default character on my copy was "[" but I decided that I preferred "≈".)

Once you've finished reviewing all the mismatched words, you can return to the word processor and use the FIND or SEARCH command to go directly to the words that need correcting. You simply have the word processor search for the special character that Spellguard implanted in the word.

The second thing you can do with a mismatched word is add it to your dictionary. Thus, as you use Spellguard you can tailor the 20 000 word dictionary that comes with the system. Don't think that 20 000 words is a small number, by the way, for as ISA remind us in the manual, an ideal dictionary would be large enough so that correctly spelled words only rarely caused mismatches, but it would still be as small as possible to save disk space, reduce running time and give as few incorrect matches as possible to words which are syntactically incorrect. Curious to see how big 20 000 words really was, I



Six munce ago
I coodnt even spel
'cumpewter programmer'
and now I are wun.

proofread every text and program source file I had at hand. The result, after proofreading 16 Megabytes of files, was a dictionary of 20 661 words (I did discard program variable names but added anything that could pass as an English word).

The third thing you can do with a mismatched word is ignore it. In virtually every document you will find mismatched words, such as proper names, that are spelled correctly but should not be added to your dictionary because they will probably never be used again.

After you have completed the review and decided to mark, add to the dictionary or ignore each mismatched word, Spellguard marks the text file, adds to the dictionary and returns you to CP/M upon your command. It will optionally, depending upon the number of words you have added, decide to "reorganise" the dictionary. I took this to mean a sort of some kind, in which case the only comment I can offer is that it is incredibly fast.

The procedures just described comprise the usual operational sequence, but Spellguard will do several other helpful things. The most important ones involve operations with dictionaries. You can combine two dictionaries so that a third contains all the words that occur in either of the two source dictionaries. This feature allows you to build a specialised vocabulary (i.e: a special dictionary) and then add it to a general dictionary such as the one furnished with the system. You can also subtract one dictionary from another so

that the third contains the words present in the first but not the second.

After using Spellguard on all my documents, I subtracted the original dictionary from the current one that contained my 661 additions. Since listing all or parts of dictionaries is another function of what the manual calls "dictionary management functions", I simply listed the remaining vocabulary. This allowed me to examine my added words, which in turn caused some reflection on some of the word pattern usage I saw. This is an aspect of using Spellguard that I had not expected but which I find quite valuable. The process of examining each word that was not in the original dictionary caused me to wonder whether some of them should be replaced by simpler, more common words. In fact I marked some words, not because they contained typographical errors or were misspelled, but simply because I wanted to replace them.

Another noticeable Spellguard characteristic is its remarkable speed. On the IMS International system with a 4 MHz Z-80 CPU and a hard disk, a 45-page, single-spaced legal document (20 066 words) was proofread in 41.2 seconds against a 20 661-word dictionary. Using a slower CPU or a slower disk system, the program would take more time.

Documentation

The manual is clear, complete and well organised, with a glossary of terms and a good index, and it goes into detail on setting up and operating Spellguard for the first-time user. I have never seen a microcomputer application instruction

manual which assumes so little and explains so much, *clearly*. The program allows you to type 'HELP' any time it expects a command. The HELP responses are clear and appropriate.

I praise the authors of the manual particularly for providing an excellent discussion of the program's limitations. Too often users of other programs are left with the chore of discovering them on their own. Five problem areas are discussed: (1) Spellguard cannot detect errors that are also real words. In fact a classic unintended example occurs on page 27 of the manual, where the word 'to' appears instead of 'so'. (2) The dictionary may contain errors. The first thought in my mind was the American spelling differences in the dictionary. In my copy, there are quite a few, but the Australian Distributors, S.I. Microcomputer Products P/L, will be supplying the Spellguard with the correct English spellings in the dictionary. You must simply make sure that you don't add any misspelled words to your dictionaries. (3) Hyphens and apostrophes cause problems and are dealt with individually. (4) Words that have more than 42 characters are flagged and need special handling. (5) The program does not distinguish between upper and lower case. On reflection upon this last point, it occurs to me that distinguishing between upper and lower case would serve no useful purpose, other than to ensure that the first word of each sentence was a capital letter — which is not the purpose of a dictionary.

The manual sums up by saying, "None of the foregoing discussion can be interpreted to mean that Spellguard eliminates the need for proofreading. Proofreading is required to make sure the document makes sense, has proper grammatical structure, verb tense, etc."

Ease of Use

I don't think any program could be much easier to use than this one. Every operation is 'menu-driven', in that a list of possible commands is presented, and the user selects the desired command by typing a letter or a number. The letters are mnemonics of the function they initiate and their numeric equivalents seem to fall neatly under your fingertips, making mismatch scanning fast and easy. Numerous little touches like this throughout the system make things easy.

Another typical example is the menu prompt for changing between beginner and expert mode (expert mode is faster and has fewer messages to the user). The main menu prompt reads: "Change prompt level from 'beginner' to 'expert'" when the system is in the

SPELLGUARD* can proofread 10,000 words in one minute

SPELLGUARD is a revolutionary new computer program that finds spelling mistakes and typographical errors in documents prepared with CP/M¹ or CDOS⁵ compatible word processors and text editors.

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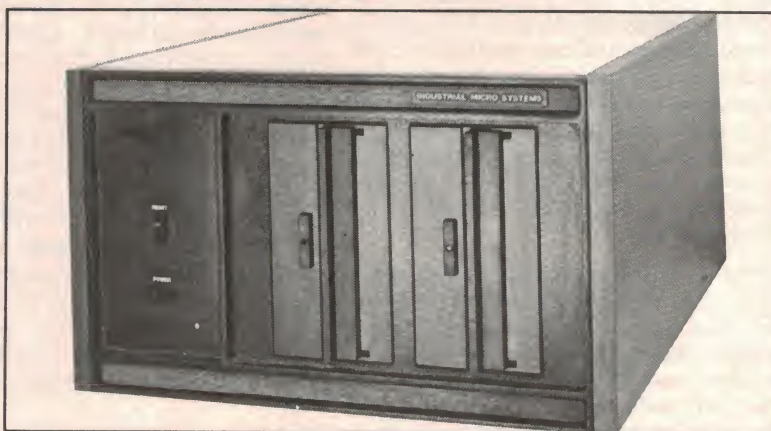
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beginner mode, but reads "expert" to 'beginner' when the system is in the expert mode.

The program uses a 'default-table' for remembering information that is likely to remain the same from one occasion to the next, such as the name of the dictionary, the special character used to mark errors and whether you have a CRT or hard copy terminal. That is not too unusual, but Spellguard allows you to have three separate tables, which is unusual. Thus you can reconfigure the system by using one command to change from one set of defaults to another, which would be helpful if more than one person were using the system.

The only inconvenience I found is that the procedure for removing words from the dictionary is rather involved. First you have to create a dictionary of words you want deleted, then use the subtract function to remove them from your main dictionary.

Error handling

I didn't experience any problems with Spellguard's error handling. The exception would be problems that are due to the way that CP/M handles BDOS errors, which can't be altered by programs like Spellguard because control is never returned to the application

program. This could conceivably cause a dictionary to crash if it happened at the wrong time, but if there is one thing which the Spellguard gets across to the operator, it is that you should always back up your dictionaries. A very wise philosophy.

Support

Here ISA's self-appointed title of innovative is appropriate. Part of the support comes with the original purchase in the form of a maintenance program with two powerful features.

The VERIFY command is a self-checking feature designed to determine whether or not the Spellguard has been damaged or miscopied. According to the authors: "If there is a random error in a Spellguard program, there is less than one chance in one billion that VERIFY will fail to detect."

The other command, REVISE, allows the user to modify the original program using a special code. This means that non-technical users can type a code such as CNA AAB AAA KBA BOF KLC into REVISE to make a patch to Spellguard. Thus ISA can distribute updates on paper rather than on floppy disks.

Clearly ISA has thought out the requirements of customer support more completely than most vendors. The ISA

approach is further indicated by its "money back acceptance test period", the warranty and the service policy — an entire chapter in the manual is devoted to these subjects. ISA even includes a preprinted form to use in claiming a refund!

Summary

I think anyone using a word processor in a business or professional setting would find that, even at \$325, Spellguard will quickly pay for itself. When I first saw the price, I thought it was too high. But after using the program and reflecting on the value of reliable, professional-quality software as an addition to a microcomputer word processor system, I think it is well worth the price. ●

System Requirements

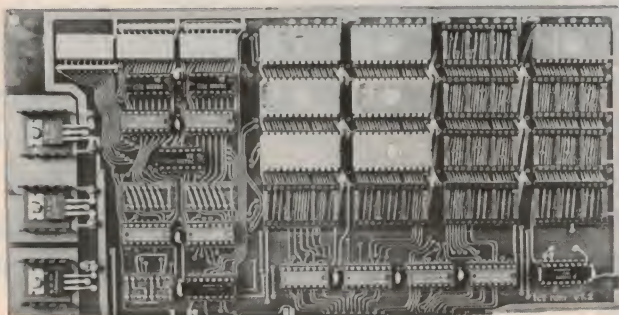
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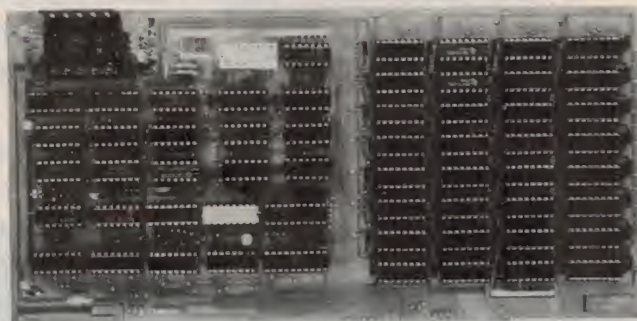
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Advanced BASIC

Part 2 — Chaining

Phil Cohen

Following the series on Back Door into BASIC, ETI has begun a series on Advanced BASIC for those who want to know where to go now. The first article of the series, 'Sorting', appeared in the June 1981 issue of ETI; this month Phil Cohen explains and illustrates 'chaining'. The language used is 8K Microsoft BASIC, and minor alterations will allow the included examples to run on almost any medium-sized personal computer system.

LET'S SAY you've got a list of items with a definite sequence — words in a word processor, or names in alphabetical order, for example. What's the best way to organise their storage in a program?

Easy, you say. Put them into an array.

Okay, but what if you want to add one item to the list, but *in the middle of the list*. What happens? One approach is to find out where the item goes and move all the items after it down one position (assuming, of course, there's room in the array). This becomes very slow if you have a lot of items in the list.

Another way of doing it is to have a separate list of 'amendments' to the existing list and to check it as the main list is read out. This is okay if the number of amendments is very small.

One solution to the problem is to use what is known as 'chaining'. Each item in the list 'points' to the next item.

Perhaps the easiest way to explain this is with an example. The list we want to represent is:

1.1, 2.2, 3.3, 4.4

This is stored in the array A(5,2). The 5 gives us room to add one more item to the list and the 2 allows the storage of 1) the data, and 2) the location of the next item:

A(1,1) = 1.1
A(2,1) = 2.2
A(3,1) = 3.3
A(4,1) = 4.4

The item after 1.1 is 2.2, and so

A(1,2) = 2

Similarly,

A(2,2) = 3

A(3,2) = 4

Now 4.4 is at the end of the list, so we'll mark this by a negative number:

A(4,2) = -1

This couldn't possibly be the next location, since the array subscripts start at 0, and so the program will be able to recognise the end of the list. We also

need a 'pointer' to the start of the list:

S = 1

The following program will print the list defined above (see also Figure 1):

10 I = S

I is the current item. Point it to the start.

20 PRINT A(I,1)

prints the current item.

30 I = A(I,2)

sets I to the *next* element's location.

40 IF I > 0 THEN 20

repeats the process until all the items have been printed. When 4.4 has been printed, line 30 will set I = A(4,2), which is -1, and line 40 will 'trap' this as the end of the list.

Fine, we can read the list out — what about adding items?

This is where it gets a bit cleverer — we don't have to move any of the data. All we have to do is to find a place for the data, point one of the list's pointers at it (*which* pointer depends on where in the list the new item is to be added) and then point the new item's pointer back into the list where it was 'broken'.

First of all, though, we have to find out if there's room. Remember, we have no way of knowing (yet) which locations hold data and which are unused (without going through the list each time, that is). What if we set the 'next item' part of the unused locations to 0. Then we'll be able to tell the locations from data, or from the 'end of list' marker (which is -1). The unused location in the above example was location 5, so A(5,2) = 0.

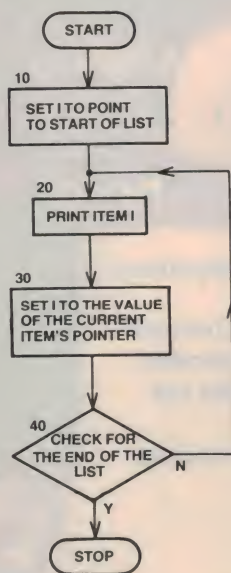


Figure 1. A program which allows the list to be printed in order.

Now see here



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What we have to do to add an item, then, is

- Look for an empty location (and STOP if there are none!)
- Change the pointer of the item which comes before the one we want to add to point to the new item.
- Set the pointer of the new item to

point to the item which will come after it.

Say we want to change the list to:
1.1, 2.2, 99,3.3, 4.4

We set

A(2,2) = 5
A(5,1) = 99
A(5,2) = 3

The following program segment will add an item with value V after item L (see flowchart, Figure 2).

```
10 FOR I = 1 TO 5
20 IF A(I,2) = 0 THEN 50
```

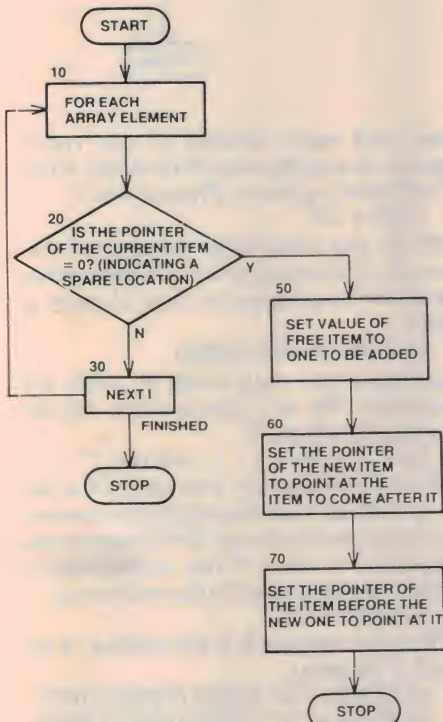


Figure 2. This segment adds one item to a specified position in the list.

```
30 NEXT I
```

40 PRINT "NO ROOM LEFT": STOP
checks for empty locations (which have a pointer value of 0) and stops if there are none.

```
50 A(I,1) = V
```

I should be the number of the first empty location.

```
60 A(I,2) = A(L,2)
```

sets the pointer of the new item to where the pointer of the item was before it was pointing (whew!).

```
70 A(L,2) = I
```

completes the addition.

The following segment will remove item R. This is rather more tricky than the last program, as we have to find out which item is pointing at item R. It won't remove R if it's the first member of the list, by the way — this involves changing the value of S. It's easy enough to add a small section of program to check for this, though (see the full-sized example later in the article).

```
10 I = S
```

the start of the list;

```
20 IF A(I,2) = R THEN 60
```

if the item I points at R, jump.

```
30 IF A(I,2) < 0 THEN PRINT
```

"NOT FOUND": STOP

If R hasn't been found by the end of the list then *something's* wrong!

```
40 I = A(I,2)
```

```
50 GOTO 20
```

try the next one:

```
60 A(I,2) = A(R,2)
```

This takes care of the pointers in the list. All we have to do now is to mark R as being empty:

```
70 A(R,2) = 0
```

Figure 3 shows the flowchart of the above program.

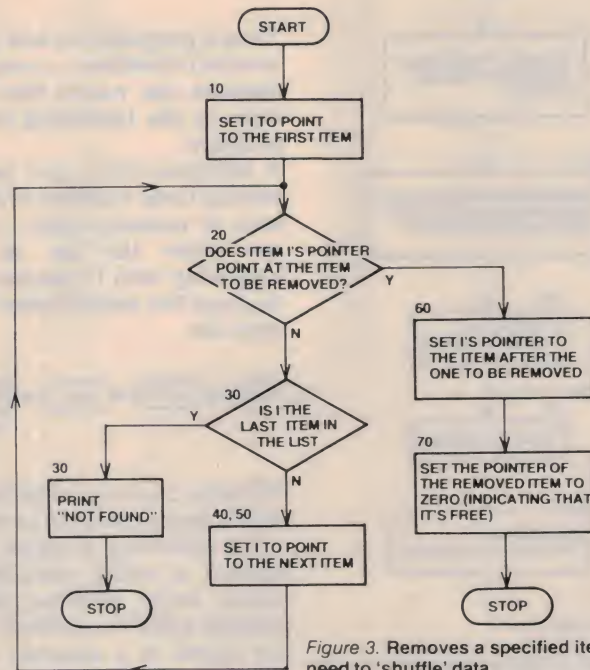


Figure 3. Removes a specified item — without the need to 'shuffle' data.

Other points to note about chaining are:

- There's no reason why there should only be one list per array. All that's required is to have several 'start of chain' pointers (like S in the above example). Remember — one array takes up less room than two of the same total size.
- Several lists can share the same 'tail'.

If this is a representation of two lists:

S1 → ○ → ○ → ○ → ○ → -1

S2 → ○ → ○ → ○ → ○ → -1

then there's no reason why they shouldn't be arranged like this

S1 → ○ → ○ → ○ → ○ → -1
S2 → ○ → ○ → ○ → ○ → -1

This sort of thing is useful for mailing list systems where some addresses would appear on several lists — members of a club who are also committee members, for instance. Their addresses would only be recorded once.

- List pointers can go in both directions:

A(1,1) = 1.1, A(2,1) = 2.2, A(3,1) = 3.3

A(1,2) = 2, A(2,2) = 3, A(3,2) = -1

A(1,3) = -1, A(2,2) = 1, A(3,3) = 2

Using the A(I,2) pointers would cause the list to be read as

1.1, 2.2, 3.3

whereas using the A(1,3) pointers would cause it to be read as

3.3, 2.2, 1.1

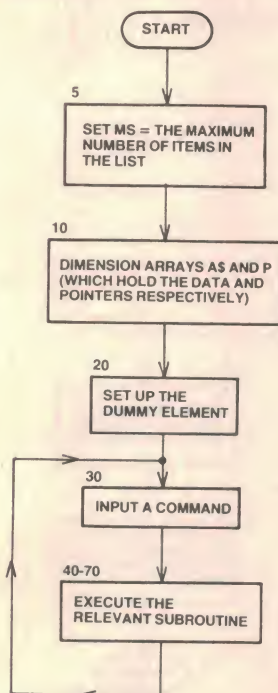


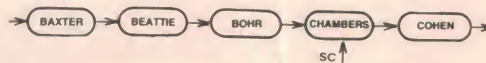
Figure 4. The main program. Flowcharts for the subroutines are given in Figures 5 to 7.

Figure 5. The remove subroutine.



Thus a program can look through a list in either direction — in word processing systems this means the ability to 'go back to the beginning of the current sentence'.

- Multiple-entry lists are useful for storing large numbers of data in alphabetic or numeric order — the program can enter the list at the 'words beginning with C' pointer when trying to place the name Carter in an alphabetic list.



- Chains can be circular, for storing repeated sequences such as rotas.

The following program will store a number of string variables in alphabetical order, allowing the list to be printed, added to or edited. The pointers are stored in a separate array to the data but the two arrays are the same

size and each element of one corresponds to one element of the other. A full flowchart is given in Figures 4 to 7.

5 MS = 50

MS is the maximum number of elements. It's best to have it set right at the start of the program so that it's easy to find.

10 DIM A\$(MS), P(MS)

A\$ holds the data while P holds the pointers. We will assume that all the elements of P are 0.

20 S = 1 : P(1) = -1 : A\$(1) = ""

This is the 'dummy' element of the list — in lists of variable size it is necessary to limit the minimum list length to one element, so that S has something to point to. A\$(1) is set to the null string.

30 INPUT C\$

C\$ is the command: R for remove, A for add, P for print.

40 IF C\$ = "R" THEN GOSUB 1000

50 IF C\$ = "A" THEN GOSUB 2000

60 IF C\$ = "P" THEN GOSUB 3000

70 GOTO 30

PART 1

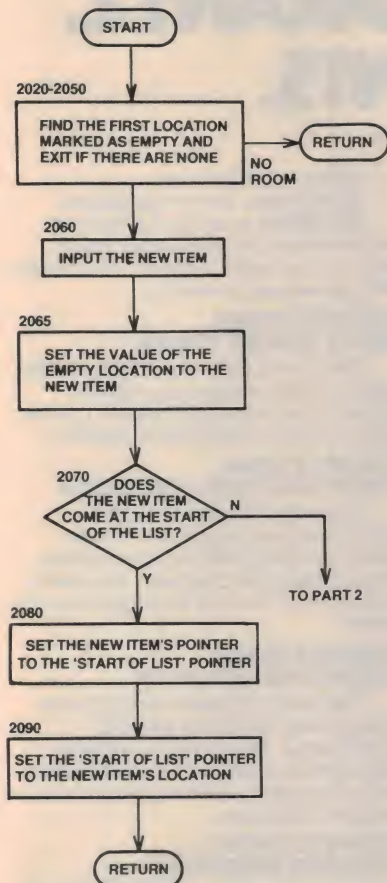
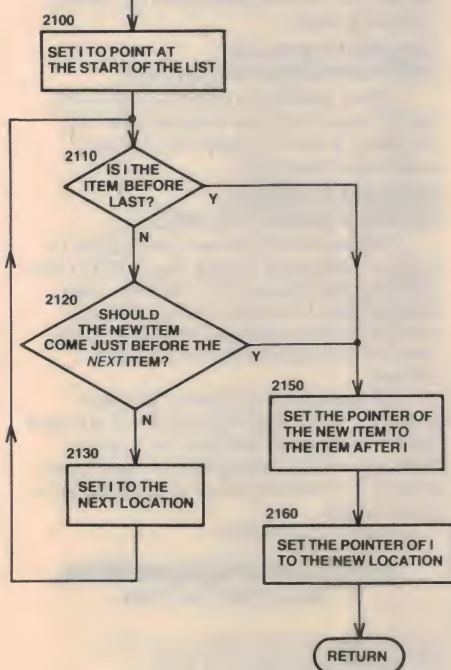


Figure 6. Add subroutine — this also checks to see if there's room.

PART 2

FROM PART 1



executes the relevant subroutine and returns for the next command.

```
1000 REM REMOVAL
      SUBROUTINE
1010 INPUT "WHICH ITEM"; W$
      finds out which item to remove.
1015 IF A$(S) = W$ THEN
      SS=S : S = P(S) : P(SS)=0
      RETURN
```

checks to see if the first member of the list is the one to be removed. As the algorithm used in the subroutine can't handle this directly, this line grabs it when it occurs. SS is a temporary store for S — see line 1080 later.

```
1020 I = S
1030 IF P(I) = -1 THEN PRINT
      "NOT FOUND" : RETURN
```

Since we're looking one item ahead — so that we can change the pointer which points at W\$ — we look for the end of the list at the item *after* item I.

```
1040 IF A$(P(I)) = W$ THEN 1065
      found W$ in the next item? — then jump
      out of the loop. If not,
```

```
1050 I = P(I)
1060 GOTO 1030
```

... try the next one. If W\$ has been found, these next two lines take care of the pointers:

```
1065 P = P(I)
1070 P(I) = P(P(I))
```

Now mark item I as being empty:

```
1080 P(P) = 0
```

P was a temporary store for the value of P(I), as we need this value at line 1080 but it has been changed by line 1070. Location I is now empty. The dummy location (see line 20) will not be removed by this subroutine, as line 1010 will not accept a null string and the routine cannot, in any case, remove the last item in the list — line 1030 would prevent it.

```
1090 RETURN
2000 REM ADD AN ITEM
      First, find out if there's room:
2020 FOR F = 1 TO MS
2030 IF P(F) = 0 THEN 2060
2040 NEXT F
2050 PRINT
      "NO ROOM" : RETURN
```

F is now the location of the first free element of the array — if there are any.

```
2060 INPUT "ITEM"; W$
2065 A$(F) = W$
```

This routine uses an alternative approach to the problem of dealing with the beginning and end of the list — the end causes problems for the REMOVE subroutine and this is why the dummy element was put in at the end. The beginning of the list will cause problems for this routine if we're not careful but we won't put a dummy element in the beginning as well — just to show the alternative approach. Instead:

```
2070 IF A$(S) < "" THEN
      IF A$(S) < W$ THEN 2100
```

If the dummy element isn't the only one in the list and W\$ doesn't come first in the list, jump to 2100. The < can be used to compare strings alphabetically in most comprehensive BASICs. If the version you're using doesn't have this feature you will have to write a short subroutine to do it. The IF ... THEN IF ... THEN construction causes the program to ignore the result of IF ' ' > W\$. If W\$ got past line 2080 then it must come just at the start of the list, so:

```
2080 P(F) = S : S = F
2090 RETURN
```

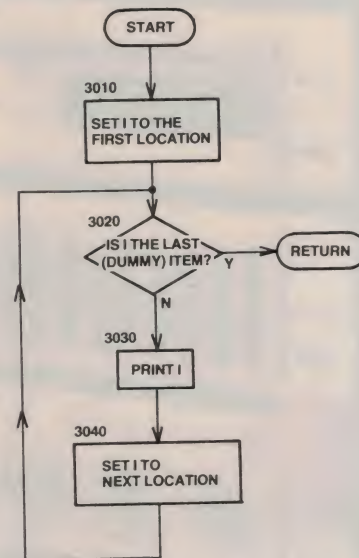


Figure 7. The list routine — the simplest of the three. Note how the addition of a dummy element makes this routine different from Figure 1.

However, if W\$ comes further down the list,

```
2100 I = S
2110 IF P(P(I)) = -1 THEN 2150
```

If the search reaches the end of the list, W\$ must come last in the list.

```
2120 IF A$(P(I)) > W$ THEN 2150
```

If the next item is further down the alphabet than W\$, it must go in just after I (and before A\$(P(I))). If not, try the next one:

```
2130 I = P(I)
2140 GOTO 2110
```

Now add location F in the right place:

```
2150 P(F) = P(I)
2160 P(I) = F
2170 RETURN
```

Now for the simplest of the three routines:

```
3000 REM PRINT
3010 I = S
3020 IF P(I) = -1 THEN RETURN
      This prevents the dummy element from
      being printed, and ends the subroutine's
      execution.
3030 PRINT A$(I)
3040 I = P(I)
3050 GOTO 3020
```


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SIGHT & SOUND



No more wild crowd scenes featuring disco dancers and robots, it seems.

Sixth C.E. Show cancelled!

In a surprise move in mid-May, Riddell Exhibitions cancelled this year's Consumer Electronics Show, scheduled to be held at the Yennora Woolsheds in Sydney over July 20 to 26.

The reason given was insufficient bookings — only 34 companies had committed themselves, compared to nearly 60 in the 1980 Show.

First held back in August 1976 in Sydney's Hilton Hotel, the show grew year by year until it occupied nearly four pavilions at Sydney's

Showground in Moore Park. The Show started out as a hi-fi show for trade and public, along the lines of America's Chicago and Las Vegas electronics shows or the All Japan Audio Show.

For the first three shows our then sister publication Hi-Fi Review gave support and was closely associated

with the event. In 1979 the scope was broadened and ETI's July issue that year carried a Show Guide in a 228-page bumper issue. Whilst the bulk of exhibitors at the 4th C.E. Show displayed hi-fi and associated gear, there was much 'consumer' electronic equipment in evidence.

The 1980 Show had more exhibitors than ever before, but some who had been prominent in previous years were conspicuous by their absence. That trend clearly turned into a mass 'include me out' this year.

Various reasons have been advanced, from lack of promotional budgets of the size required to mount a stand at the C.E. Show to lack of interest by company managements. Certainly there was some rivalry amongst the big show exhibitors as to who could mount the 'most brilliant' stand in years past, and if a company couldn't mount an exhibit to match the brilliance of the Opera House then they risked looking second best. It's easy to understand the attitude of '... rather not be there than be second best'.



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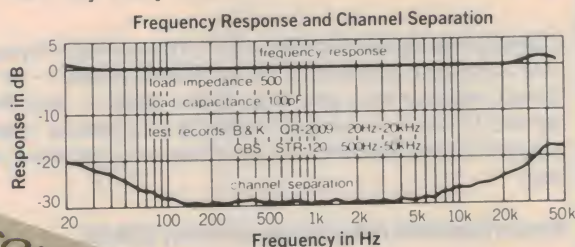
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DC resistance:	40Ω
Impedance:	40Ω (1kHz)
Load impedance:	More than 40Ω
Compliance:	15x10 ⁻⁶ cm dyne
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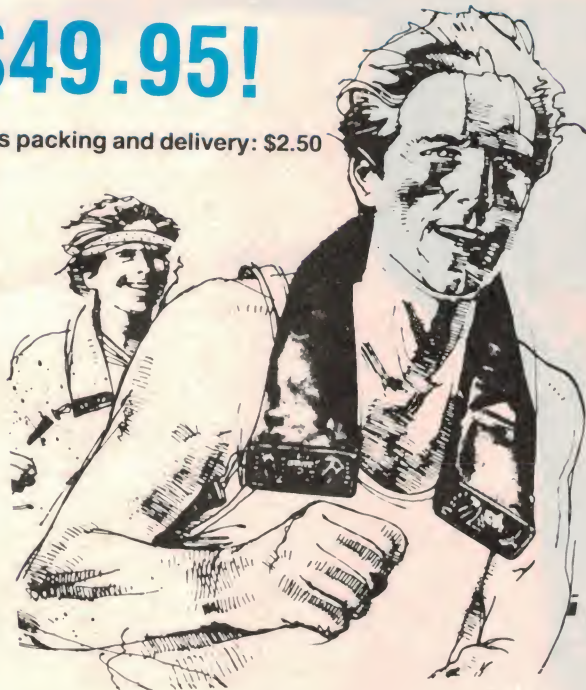
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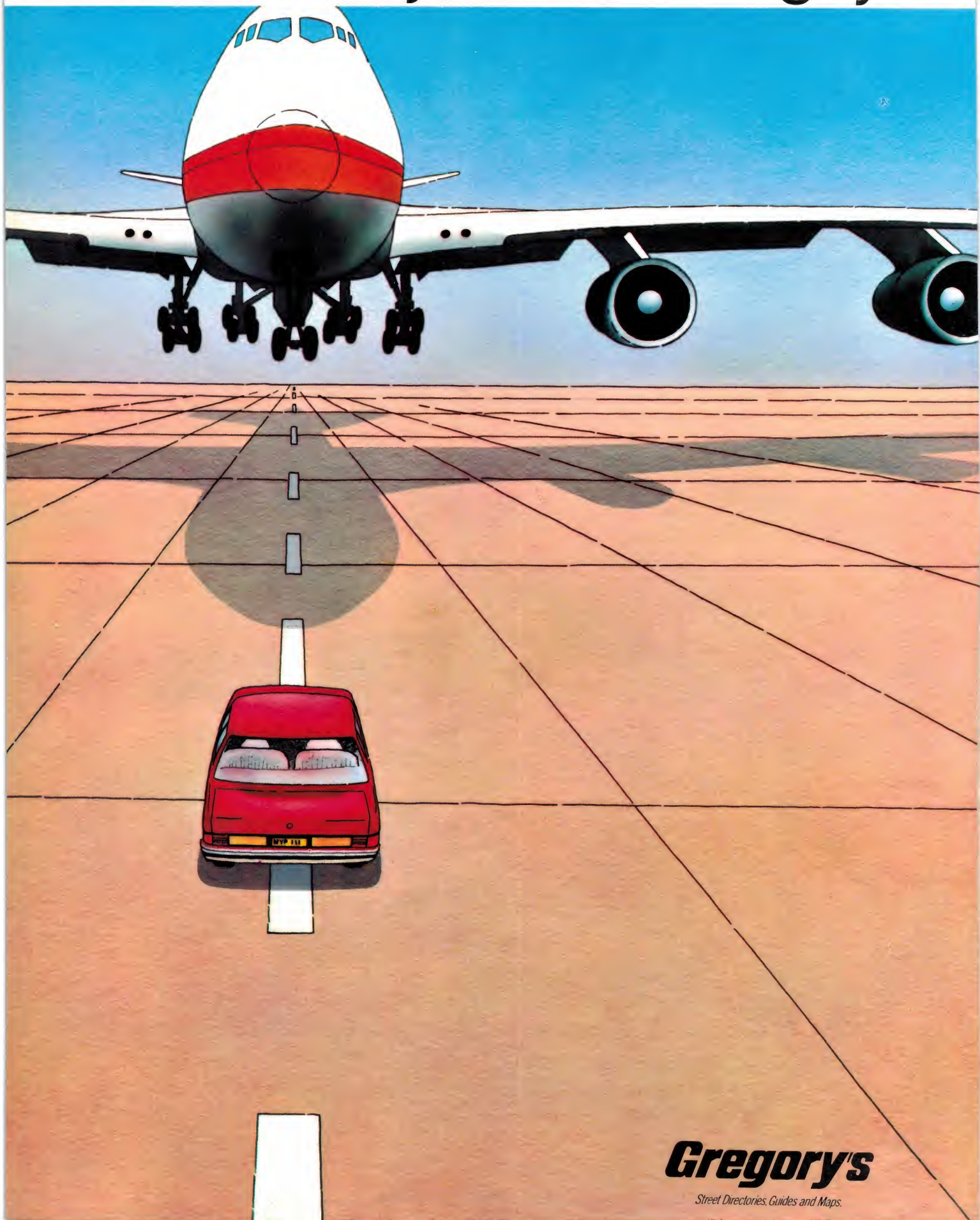
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Portable video system from Sanyo

Sanyo Australia has added a portable Beta format video recorder system to its range of video equipment.

The system consists of a VTC 3000P portable recorder, a VRF 300P tuner/timer unit, an ac adaptor, a VBT 300 rechargeable battery pack, and a VCC 350P colour video/sound camera.

The VTC 3000P recorder has audio dubbing facility and a timer standby function. The recommended camera is equipped with an optical viewfinder and a zoom lens with rangefinder, but the Sanyo VCC 545P colour video/sound camera is also available as an alternative with electronic viewfinder for monitor playback.

When used as a home video system, the tuner/timer unit offers automatic recording over a one-week period — five programmes on any channel. The VRF 300P tuner has UHF/VHF 12-channel selection with soft touch controls.

Recommended retail prices are: VTC 3000P portable recorder — \$1599 including carry case; VRF 300P tuner/timer — \$599; VAR 300 ac adaptor — \$159; VCC 350P colour camera — \$999; VBT 300 rechargeable battery pack — \$59.

For further information contact Sanyo Australia Pty Ltd, 225 Miller St, North Sydney NSW 2060. (02) 436-1122.



Hitachi's Triple Cube

Hitachi have recently introduced what they claim to be the ultimate in hi-fi housing versatility, their 'Triple Cube' system.

This equipment consists of three cubical units which may be stacked in a variety of configurations as best suits your available space and taste.

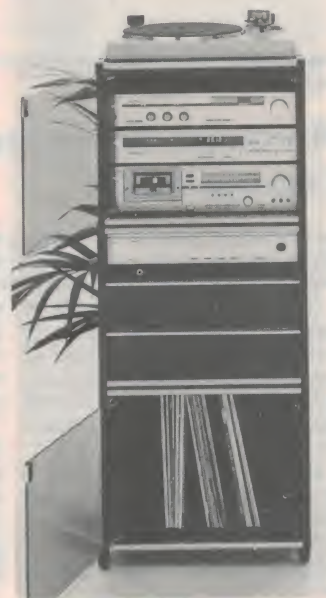
The units may be stacked on top of each other, as in the photo; the record storage cabinet can be placed quite separately from the other two units; or the three units may be placed alongside each other and fastened to a wall at a convenient height for operation. The loudspeakers could then be placed on the floor at each end of this horizontal configuration. Each unit of the series is also available separately, plus matching loudspeakers.

The cabinet modules are finished in simulated black ash, and the main cabinet will house any amplifier, tuner or cassette deck from the Hitachi slimline range, including the new FT 10RM tuner and the HT 10RM turntable.

An RM1000 remote control unit is also available, which enables the hand-held RB 1000 transmitter unit with its 28 push keys to control the turntable, amplifier, tuner and cassette deck — all from the comfort of your armchair!

Each cubical unit is approximately 475 mm wide, 375 mm high

and 400 mm deep, while each of the loudspeakers is 254 mm wide, 470 mm high and 264 mm deep. There is considerable space for both disc and cassette storage.



Toshiba releases 'Mini-Component'

Toshiba's SK-02 L-Component, designated 'little brother' to their SK-01 unit, combines an amplifier, AM/FM tuner and cassette deck in one stylish package measuring only 350 x 308 x 160 mm.

The SK-02 can be mounted directly on to a wall, or placed on a shelf, in a cabinet, on another piece of furniture — the 'L' in the designation is said to represent 'layout freedom'.

The SK-02 has sleek modern lines, carefully spaced controls, and

a brushed aluminium finish, and features metal tape compatibility, a 'Music Track Skipping Selector' (MTSS), and a Dolby noise reduction system.

Any Toshiba dealer can provide more information on the SK-02 L Mini-Component.

Telex your tape recorder?

Telex Communications Inc. are now marketing what they call a new 'tape transport' — that is, a motor unit for tapes that is compatible with the Telex RP85 record/play preamp.

The 3000 series transport is a three-motor unit which accepts reels up to 10½" (267 mm), and is available for 3.75 and 7.5 ips or 7.5 and 15 ips in 120 V/60 Hz or 240 V/50 Hz versions. One, two and four-channel systems are available.

Amongst many other features, the 3000 has a variety of interchangeable head configurations from half track/single channel to quarter track/four channel. These are easily mounted on a heavy-gauge assembly plate which will accommodate up to four heads.

Suggested user price for the 3000 series tape transport begins (!)

at US\$1950, and further information may be obtained from Ron Taylor, Telex Communications Inc, 9600 Aldrich Avenue South, Minneapolis MN 55420, USA.



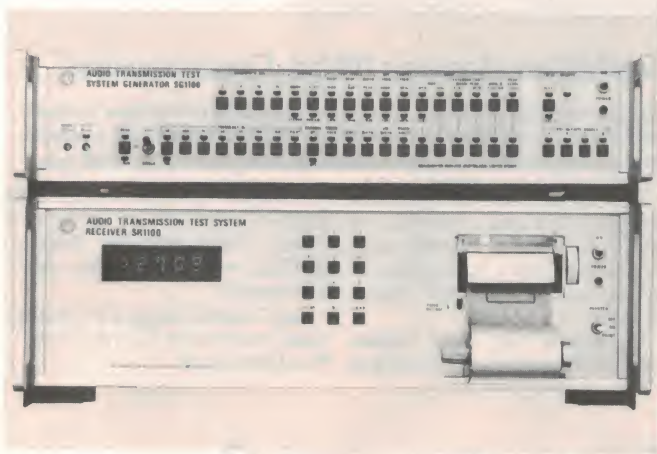
Test engineers to go automatic?

The North Ryde division of AWA, of which Mr. Barry J. Leather was recently appointed Instrumentation Department Manager, has designed and developed a new automatic audio transmission test system, claimed to set new standards for automatic monitoring and testing of mono or stereo sound transmission chains and associated equipment.

The S1100 is said to measure up to 43 significant transmission parameters and report in approximately 3.5 seconds on sound and television broadcasting chains, telecommunications systems, bearer links and tape recorders, and can also be used during equipment production. This kind of testing is at present carried out manually by an engineer, but this automatic equipment is claimed to take over many of the duties of such an engineer.

Parameters tested include receive absolute level, frequency response, total harmonic distortion, intermodulation distortion, RMS noise, stereo crosstalk and phase, peak level, wow and flutter, and quasi-peak noise weighted and unweighted.

For more information contact Brian M. Carey, Commercial Public Relations, 157 Walker St, North Sydney NSW 2060. (02)929-4911.



Two Sanyo 'bookshelf' hi-fi systems

Sanyo's new System 8 and System 10 hi-fi systems are both compact and slimline and incorporate an amplifier, tape deck, tuner and matching speakers.

The System 10 amp is 22 W RMS per channel with loudness contour control, volume, bass and treble controls. The AM/FM tuner has a five-LED signal strength meter, FM/Auto muting, fly-wheel tuning and a LED FM stereo indicator. The tape deck has bias and equalisation settings for all tape types, LED level meters, line/mic input selector and dual rotary input controls. The speaker system is a high-performance two-way type incorporating a 10 cm free-edge woofer and a cone tweeter. Rrp is \$886.

The System 8 output is also

22 V RMS per channel, and the amp has a subsonic filter, loudness control and LED function indicators. The AM/FM tuner has a five-point LED signal strength indicator, LED tuning indicator and a large tuning scale. The tape deck is equipped with Dolby, metal tape facility and LED record level meters fitted with separate left/right level controls. The speakers are similar to those in the System 10. Rrp is \$775.

For further information contact Mr. R. Hopwood, Sanyo Australia Pty Ltd, 225 Miller St, North Sydney NSW 2060. (02)436-1122.



The Mordaunt-Short Carnival Series 2 200 mm two-way system sells for a mere \$398!

Mordaunt-Short speakers from Concept Audio

As a result of a recent agreement with Mordaunt-Short Ltd of the UK, Concept Audio will shortly be marketing Mordaunt-Short loudspeakers throughout Australia.

Sales of Mordaunt-Short speakers in the UK, their country of origin, are claimed to have reached unprecedented levels, and business in the USA has become so brisk that Mordaunt-Short have also established their own corporation there.

Concept claims that Mordaunt-Short speakers will be the most competitively priced fully imported speakers on the Australian market, citing the Carnival Series 2, an 8" two-way, finished in genuine walnut,

as an example at \$398. The Pageant and Festival Series 2s and the newly released Signifiers will complete the Mordaunt-Short range and will also be competitively priced.

Full reprints of world-wide reviews of Mordaunt-Short speakers are available on request, plus a fully descriptive catalogue, from Concept Audio Pty Ltd, 22 Wattle Rd, Brookvale NSW 2100. (02) 938-3700.

New 'state of the art' Telex wireless microphone system

Telex Communications Inc. has introduced a VHF wireless microphone system utilizing new diversity reception circuitry.

The Telex FMR-1 operates as a conventional FM wireless microphone receiver when only one antenna is installed, and automatically operates as a dual diversity receiver when two antennas are used.

The combined signal of the two antennas is automatically phase shifted by the receiver for the best signal-to-noise ratio. The system is so effective against switching noise and the common problem of 'drop-out' or 'picket fencing' that Telex has applied for a patent on the unique diversity circuitry.

A belt-pack transmitter, WT-100, is battery powered; roughly the size of a package of cigarettes, this

transmitter is easily concealed under clothing. A standard LEMO connector accepts the extremely small Telex WLM-100 electret lavalier microphone. A four foot (1.22 m) adaptor cable is provided with each belt-pack transmitter for instant adaptation of any low impedance microphone with a male XLR-type connector.

The Telex WHM-300 Handheld Transmitter/Microphone is lightweight and extremely slim, and there are no unsightly antenna protrusions or trailing wires. Both a ball screen and slotted head screen are supplied with each unit to instantly change the appearance when desired.



The Telex wireless microphone system operates in the 150-174 MHz range and is crystal-controlled single frequency. A full line of accessories is available, including a log periodic antenna

with high, unidirectional gain useful in large stadiums and auditoriums.

For further information contact Ron Taylor, Telex Communications Inc, 9600 Aldrich Avenue South, Minneapolis MN 55420, USA.

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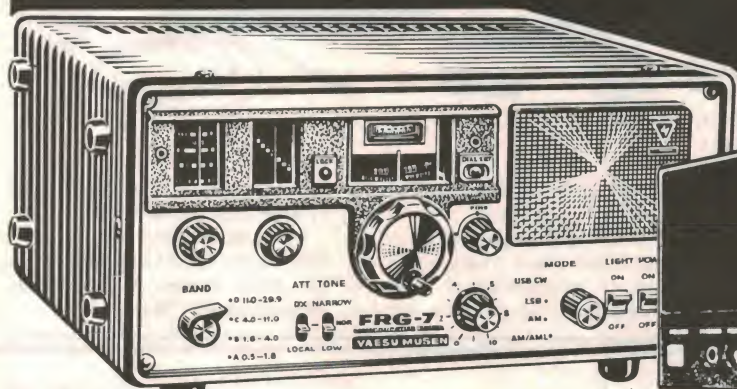


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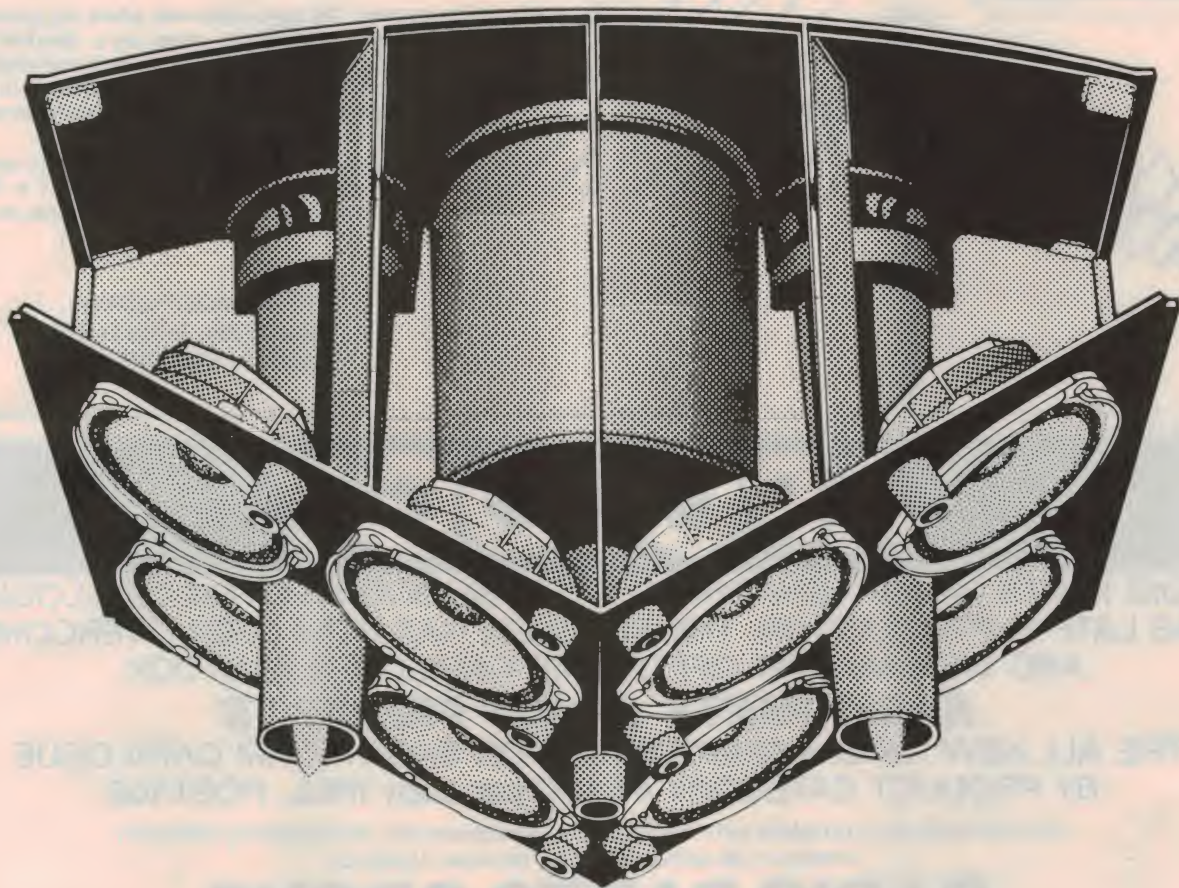
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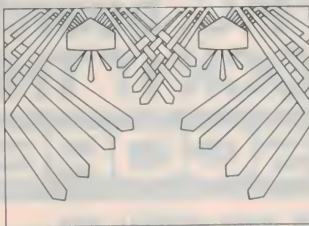
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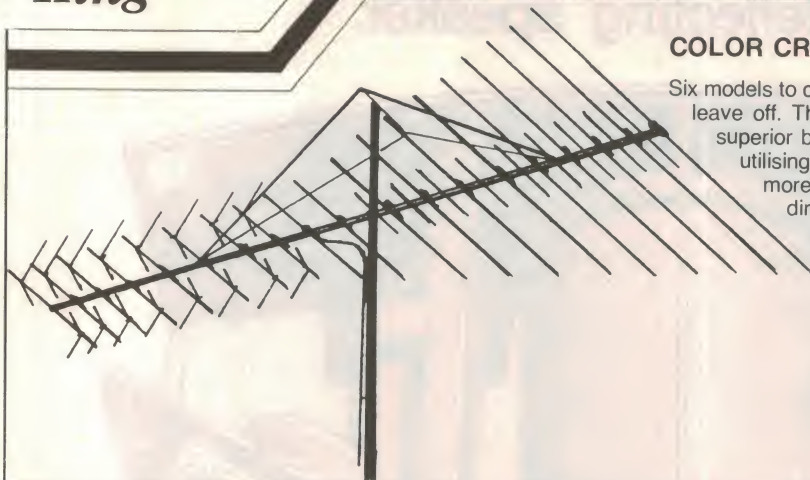


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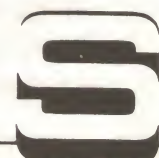


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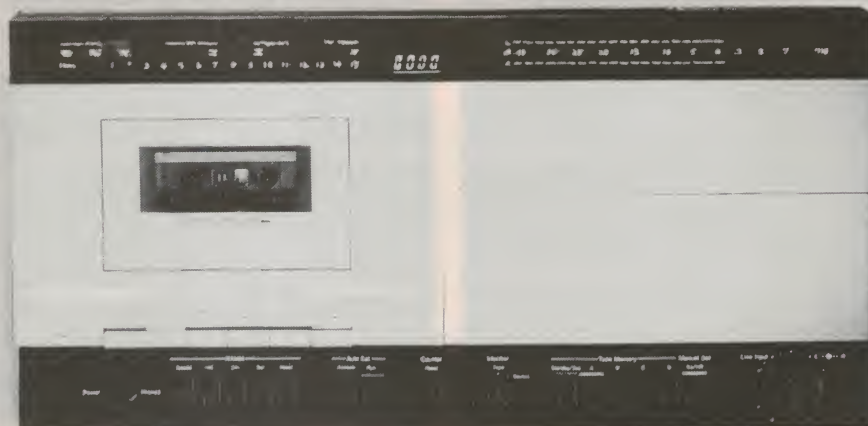
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Technics SB-10 speakers

Louis Challis gives the SB-10s the accolade of being "the finest Japanese loudspeakers I have yet heard". What more needs to be said?

Louis A. Challis

EVERY MANUFACTURER of loudspeakers will tell you that they are the weakest link in the reproduction chain of a hi-fidelity system. Most manufacturers, when releasing their latest or greatest loudspeaker, will claim that *this* product finally overcomes the deficiencies plaguing previous models.

On this rare occasion the manufacturer does not speak with a forked tongue; there is definite substance both in the claims made for the Technics SB-10 speakers, and more particularly in the subjective and objective results achieved.

In January of this year we discussed in ETI the extent to which the Japanese speaker manufacturers have been carrying out research work along parallel lines to English loudspeaker manufacturers. Matsushita Electric have undoubtedly been at the forefront of the Japanese manufacturers in developing their laser/holography and finite element method of loudspeaker enclosure analysis to determine the modal characteristics, not only of the cabinets but more significantly of the all-important loudspeakers themselves.

The approach

Technics' approach to this problem has been a little different from that of either K.E.F. or B & W in the United Kingdom, or for that matter from other Japanese manufacturers, the majority of whom have tended to stay with the conventional concept of a loudspeaker.

Technics' engineers decided that in order to achieve a true piston-like motion for a loudspeaker, the basic design philosophy used in the past of having a paper cone, a conventional voice coil and a conventional small magnet assembly would have to be discarded.

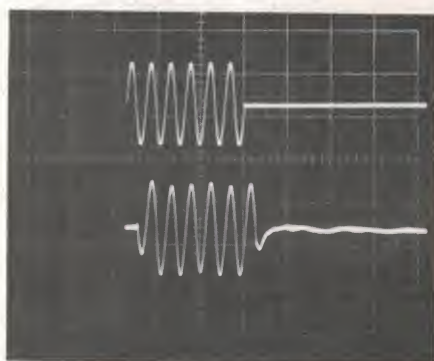
The conical shape of the conventional loudspeaker has never really been a virtue and had always resulted in speakers whose cones could be readily induced into resonance at one or more frequencies. These resonances cause poor linearity and destroy high-fidelity performance. Technics' approach to this problem was to change from the basic concept of a cone to a flat diaphragm with strength and rigidity substantially better than in any loudspeaker previ-

ously constructed. They discarded such principles as aluminium or polypropylene stiffened fibre cones in preference to a material developed by the aircraft industry in the form of an aluminium honeycomb structure.

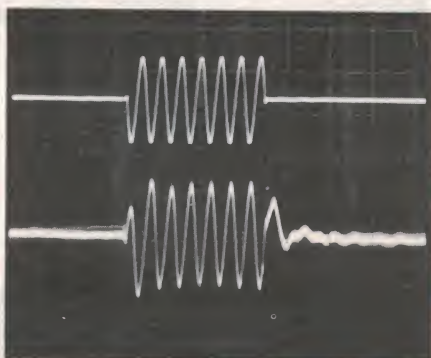
By using an axially symmetrical structure of honeycomb formed into a spirally wound disc with flat stiffening plates above and below, they were able to achieve a stiffness which is almost one hundred times that of comparable paper cone diaphragms. The primary fundamental resonance frequencies were then transposed up to the kilohertz region for the woofer.

The drivers

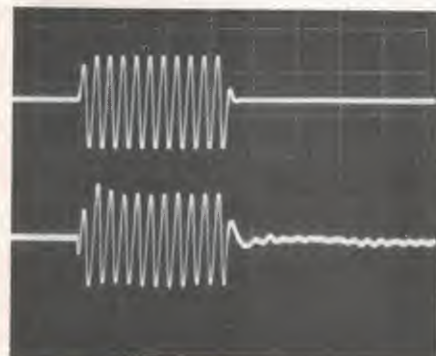
Obviously this approach could still create problems if the voice coil were considerably smaller than the diameter of the speaker diaphragm. To overcome this problem Technics developed a speaker voice coil with a diameter of 160 mm, which provided balanced drive to the face of the honeycomb speaker disc. A typical cross-section of the low frequency driver is shown on page 125 (for the 32 cm honeycomb disc woofer)



100 Hz (20 ms/div.)



1 kHz (2 ms/div.)



6.3 kHz (0.5 ms/div.)

Tone burst response of Technics SB-10, Serial No. BA0J20B008 (for 90 dB steady-state SPL at 2 m on axis). Upper trace is electrical input; lower trace is loudspeaker output.



and this shows how the resonance problems were minimised and the total voice coil power dissipation rating increased as a result. The 80 mm mid-range driver is built on the same principles but the voice coil here is a more conventional 50.5 mm in diameter. The mid-frequency driver covers the frequency range 450 Hz to 5 kHz, and the top end of the response is provided by a leaf tweeter whose frequency response extends to beyond 100 kHz.

The top end of the frequency response must have caused Technics' engineers a great deal of concern and possibly even anguish. They had to produce a 'state of the art' solution that was efficient, provided a flat frequency response, low distortion and good dispersion.

The leaf tweeter that resulted is unusual, for Technics have developed a tweeter which provides a remarkably flat on-axis response. The frequency response extends to beyond 20 kHz — the upper frequency with which we are

normally concerned — and Technics claim that it works all the way to 120 kHz, which is way up above the range of human hearing. This tweeter makes use of a patterned polyimide film diaphragm with a heat-resistant aluminium voice coil to achieve a device with the characteristics of a ribbon tweeter but the impedance of a more conventional loudspeaker. As no transformer is required to match the tweeter to the rest of the system, phase and transient limitations are positively minimised.

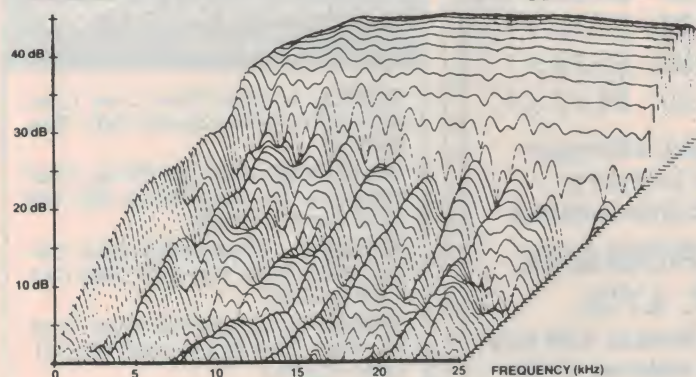
The loudspeakers

The SB-10 is an attractive loudspeaker system, featuring a black-lacquered, veneered cabinet with the same finish on all six faces. The front grille features an open-weave black cloth over a frame which latches into four sensible recessed catches on the front face. Behind this grille a tweeter and a separate mid-range frequency contour control are located, which provide up to a nominal 20 dB of mid-range and high frequency attenuation in reference to the flat response setting.

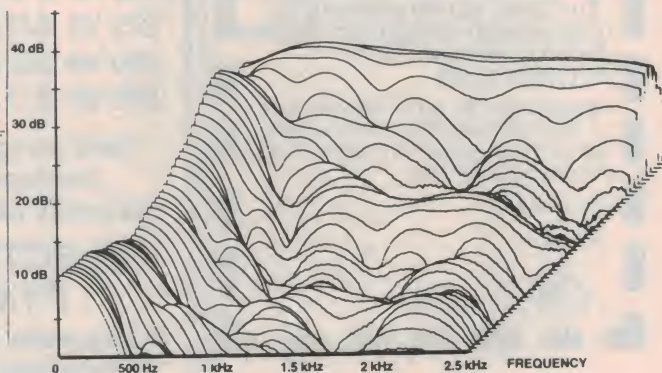
In addition to these two front-panel controls the designers have incorporated three separate self-powered protection circuits for the woofer, mid-range and tweeters, so that in the event of excessive voltage drive the speakers are protected from an untimely demise.

The back of the cabinet features a simple pair of screw terminals in a recessed plastic moulding, which regrettably do not accept the conventional banana plugs I believe most users would prefer.

The speakers themselves have a particularly high standard of finish, incorporating not only the aluminium-faced honeycomb structure of the disc ►



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Spectral decay plot to 2.5 kHz, covering the bass and mid-range regions.

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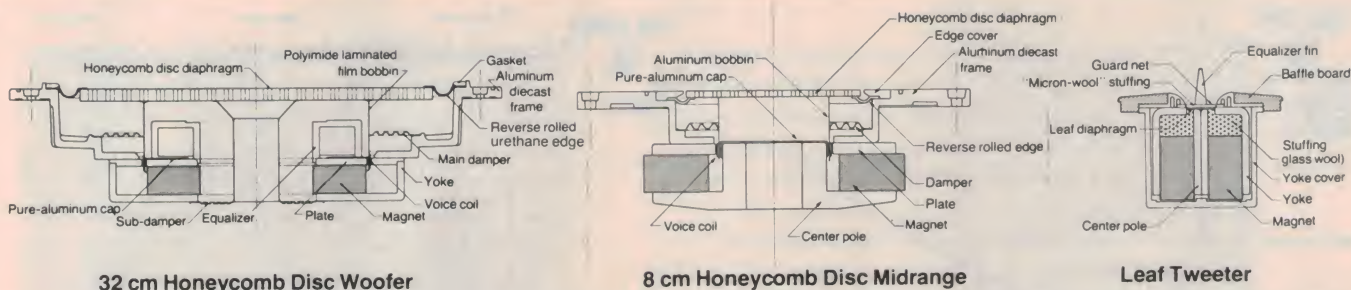
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CANBERRA: 25 Lonsdale Street, Bradon, ACT. 2601. Phone (062) 48-6751. Telex AA22703.



32 cm Honeycomb Disc Woofer

8 cm Honeycomb Disc Midrange

Leaf Tweeter

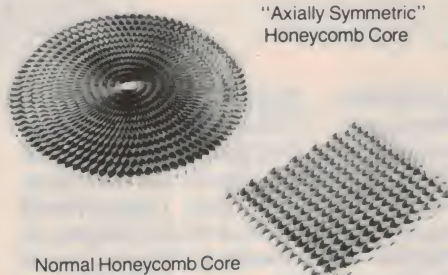
but also the frames round the speaker basket. This finish is so good that many users may wish to discard the grille in order to impress their friends with the speakers!

On test

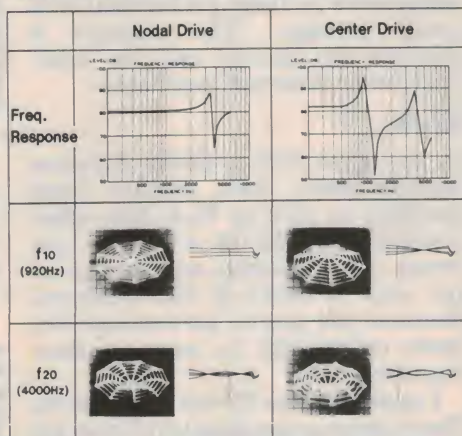
The objective testing proved exciting, as the SB-10s exhibit a remarkably flat frequency response which extends from below 35 Hz to beyond 20 kHz. The on-axis tweeter response in particular is remarkably smooth, whilst at 30° to the main axis it is still only 6 dB down at 20 kHz. The off-axis response does exhibit some interaction between the tweeter and mid-range unit, but the ripples that result come from the interaction of the two halves of the driver's phase responses as one moves to one side or the other.

The phase response of the SB-10 is remarkably smooth and shows how well the honeycomb disc speakers overcome the phase problems and the normal cavity effect created by the conventional cone loudspeaker.

The speaker's fundamental resonance occurs at 43 Hz, with a fairly significant rise in impedance, approaching 30 ohms. This value drops down to a stable 6-7 ohms in the 100 Hz region and then fluctuates between 16 ohms and 8 ohms across the



The 'axially symmetric' honeycomb core of the driver diaphragms compared to normal 'linear' honeycomb structure. The honeycomb core is sandwiched between thin aluminium sheets.

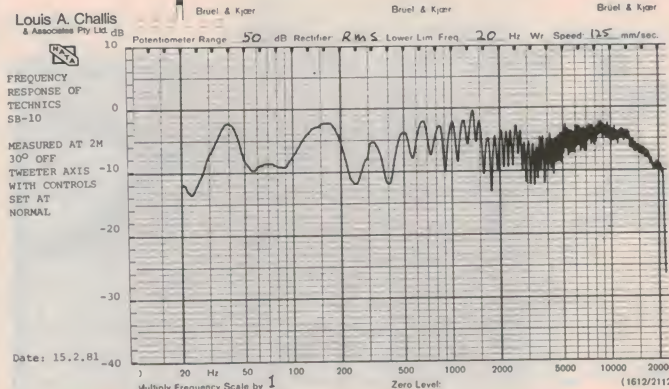
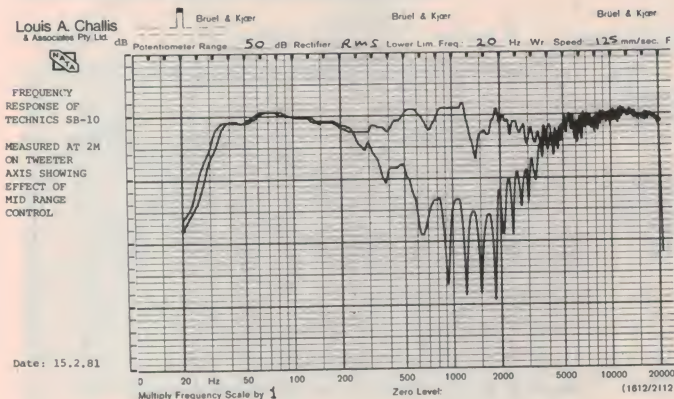


Illustrating how the range of 'piston motion', and thus frequency response, is increased by nodal drive.

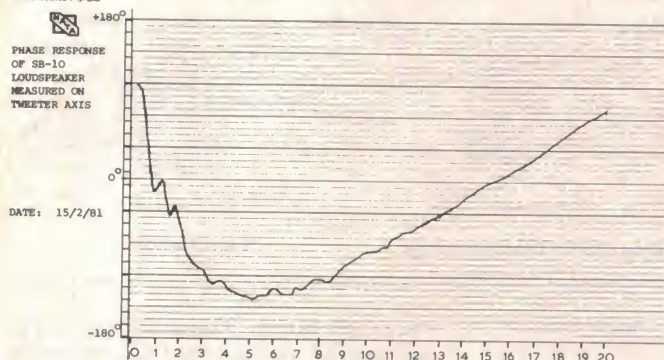
rest of the range. Whilst the mid-range and tweeter contour controls do enable one to change the characteristics of the loudspeaker, it is questionable whether anybody would really want to make use of the controls because of the resulting non-linearity.

The decay response spectrum of the SB-10 is remarkably smooth and exemplary. Whilst there are some observable ripples 20 or more decibels down compared with the fundamental, these come from the speaker basket and the residual cabinet resonances. This speaker comes close to matching the performance of the B & W 801 that we reviewed in the January issue — and that performance was a particularly hard act to follow.

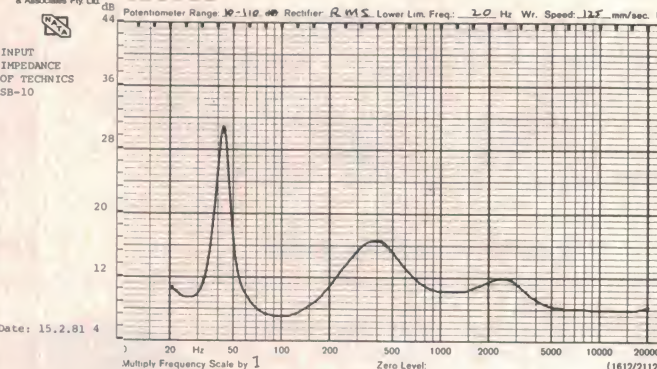
It is clear from the decay response spectrum that Technics have achieved just about everything they claim in terms of minimisation of speaker and cabinet resonances. The responses in the range 0-2.5 kHz and 0-25 kHz are as flat and as smooth as one could reasonably desire. Even the conventional tone-burst responses proved to be particularly good, and more importantly the total harmonic distortion measured over the range 100 Hz-10 kHz is amongst the lowest we have yet measured from any speaker at the 90 dB output at 2 m.



Louis A. Challis
& Associates Pty Ltd



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The subjective testing of the loudspeakers has to be related to the objective testing, and I kept the SB-10s at home for a number of weeks carrying out many direct comparison tests on an A-B basis with the standard monitors, with speakers I have not used for many years, and with a series of other speakers including a pair of B & W 801s and a pair of Quad Electrostatics to provide reference standards for comparison.

The first, immediately obvious attribute is the magnificent stereo imaging the SB-10s provide. These speakers match the B & W 801s in this area and surprisingly come very close to matching the B & W 801s in most of the other prime areas, including frequency response, power handling capability, efficiency and overall linearity. Whilst there are subtle differences between the SB-10s and the B & W 801s they do, nonetheless, have many features in common, and it is a credit to both systems how well they perform.

In playing a wide range of high quality records, including two new ones — "Yehudi Menuhin and Stephan Grappelli — Strictly for the Birds" on Angel Records DS-37710 and "Morton Gould and the London Symphony

Orchestra — Digital Space" on Verese Sarabande VCDM 1000.20 — it became evident that the SB-10s are able to handle without significant problems subtle transients and high-powered signals that would normally destroy or disturb other speakers. Thus at sound pressure levels in excess of 100 dB there is absolutely no trace of distortion, no audible colouration, and they are able to handle the signals in a manner that is comparable to large professional rock group speakers. The response is however far cleaner and the inter-modulation distortion much lower.

Well ... ?

If you have ever believed Japanese manufacturers can't produce loudspeakers as good as those from other countries, the SB-10s will prove you wrong. These speakers are avant garde not only in terms of their technical features and proven performance but more importantly in terms of their acoustic fidelity.

I must rate the SB-10s as being the finest Japanese loudspeakers I have yet heard and acknowledge that they provide a performance only surpassed by speakers selling at more than twice the price.

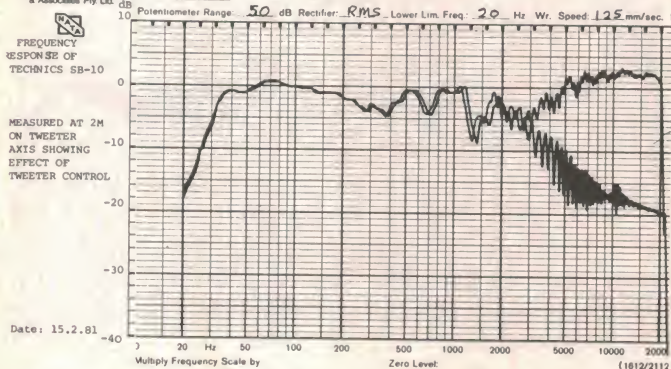
MEASURED PERFORMANCE OF TECHNICS SB-10			
SERIAL NO. BA0320B008			
FREQUENCY RESPONSE:		32Hz - 20KHz	
CROSSOVER FREQUENCIES:		300Hz - 3kHz	
SENSITIVITY:		9V RMS = 10.1 Watts (nominal into 8Ω)	
HARMONIC DISTORTION:		(For 90dB average at 2m)	
		100Hz	1kHz
		6.3kHz (@ 87dB)	
2nd		-45.3	-53.1
3rd		64.8	-49.9
4th		-	-65.2
5th		-	-
T.H.D.		0.5%	0.39%
INPUT IMPEDANCE:		100Hz	7.2Ω
		1kHz	10.4Ω
		6.3kHz	8.0Ω
		Minimum at 100Hz	7.2Ω

TECHNICS SB-10 SPEAKERS

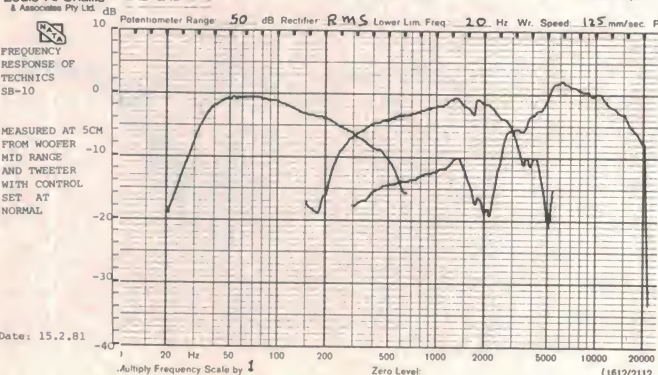
Dimensions: 711 mm high x 402 mm wide x 318 mm deep
Weight: 32 kg
Manufactured in: Japan by Matsushita Electric Limited
Price: \$1598 pair
Distributed by: National Panasonic, P.O. Box 319, North Ryde NSW 2113.

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What's new in cassette decks at Sansui?

For starters, you won't find any belts, cams or gears in the capstan drive system of the new D-550M cassette deck. They've all been eliminated in the name of speed precision and transport reliability.

This simplified transport utilizes a newly-developed direct-drive motor for capstan drive. A built-in FG (Frequency Generator) Servo system regulates it with unerring electronic accuracy while a completely independent second motor drives the reels. It's no wonder the wow and flutter specification of the D-550M is one of the lowest in its price range - less than 0.035% (WRMS).

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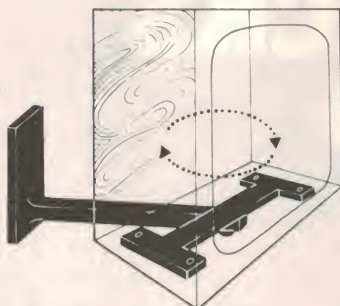
D-550M

Sansui

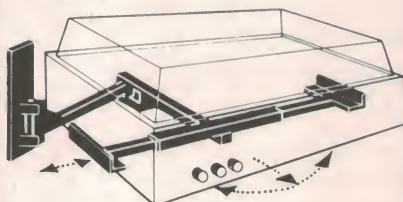
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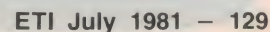
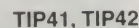
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The circuit uses a well-known configuration which has common emitter input stage (Q1) direct coupled to a common emitter drive stage (Q2), which is in turn direct coupled to the complementary emitter follower output stage (Q3-Q4). R7 provides virtually 100% negative feedback at dc, giving the circuit approximately unity voltage gain at dc. R1, R2 and R4 form a potential divider which biases the input of the amplifier to about half the supply

D1 is used to give a small standing bias to the output transistors, and together with the fairly substantial amount of negative feedback used, reduces crossover distortion to an unnoticeable level. The emitter follower output stage gives the circuit a low output impedance so that the low impedance load can be efficiently driven with the high output currents involved

The circuit requires a stabilised supply of about 18 to 22 volts that is capable of providing up to 400 mA. Q2 should be fitted with a clip-on TO5-size heatsink. Q3 and Q4 are both fitted with commercially made, finned, bolt-on heatsinks. ●



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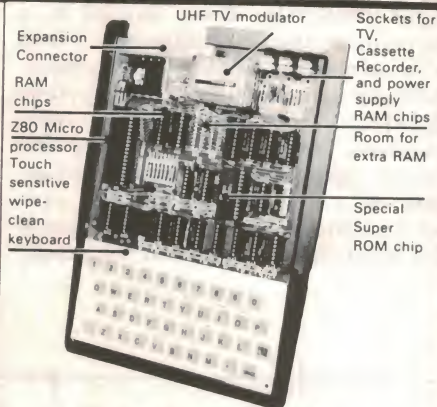
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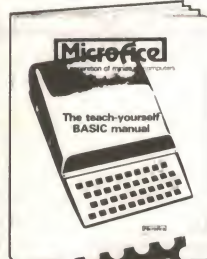
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The Series 4000/1 4-way loudspeakers — a personal revamp

Our reader had constructed a pair of ETI-439 3-way loudspeakers (Dec. '75), adding concrete damping and extra bracing, and was very pleased with them. He couldn't resist applying his 'treatment' to David Tilbrook's Series 4000 4-ways — with surprising, and pleasing, results! He reveals here details of 'the treatment'.

Garth Pennington

11 Moldavia Wlk, Osbourne S.A. 5017

WHY SHOULD I go to the expense and effort of building another set of speakers when my old concrete-braced 439s gave me very clean and dynamic sound? The answer is simple — I am bitten by the most addictive and subjective bug in our society — hi-fi. When a new system is offered, one can't help but wonder if the technical changes reveal any obvious sonic improvement.

I am not one who enjoys working long hours in the shed. The only consolation was the promise of better speakers. It took much patience to go carefully through the steps I had planned for their construction, without any short cuts.

The objects

The objects of the variations detailed here were:

- 1) Increasing box strength by using —
 - 18 or 20 mm high-density chipboard.
 - liberal use of internal bracing.
 - coating internal surfaces with thinned Estapol.
 - adding a layer of concrete to the front baffle.
- 2) Reduction of standing/reflected waves on the front baffle by —
 - mounting the midrange and tweeter on sound-absorbing material.
 - raising all drivers off the front baffle to enable the grille frame to be recessed, thus removing the reflective front edge, even when the grille frame is in position.



I feel anyone attempting these boxes should have some handyman experience and much patience, as they take considerable time and effort to build. The following notes should be taken as hints to construction, supplementary to the original article (February 1980), and should enable you to construct your own boxes in the manner I have.

Note that, amongst the obvious mechanical alterations, I have made a slight modification to the exterior appearance by putting in a chamfer 100 mm up from the base, as can be seen in the drawings and pictures.

I have largely illustrated this article with pictures as they show more clearly the construction techniques I have employed. ▶

NOTE

This article should be read in conjunction with the constructional article on the Series 4000/1 4-way loudspeakers, published in the February 1980 issue of ETI, also reprinted in Top Projects Vol. 6. The details of the revamp given here are *additional* to the basic construction details given in the original feature. We present this article as one reader's ideas and experience with particular modifications of his own design. Whilst we have checked their feasibility, we have not been able to verify the results for ourselves. Readers wishing further information should contact the author.

Roger Harrison
Editor, ETI



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Over 20 of our top-popularity projects from recent years' ETIs plus several projects from a few years back that have enjoyed renewed interest. All assembled in one big volume — there's something to suit every electronics enthusiast's interest, from the ETI-250 Simple House Alarm to the ETI-1500 Discriminating Metal Detector, from the ETI-325 Auto-probe to the ETI-562 Geiger Counter, from the ETI-724 Microwave Oven Leak Detector to the ETI-565 Laser. TWENTY projects, in all — PLUS: 'An Introduction to Lasers', 'pH — the Acid Test' and 'Experimenting With Ultrasonics'. Top Projects Vol. 7 also contains a Shop-around guide on where to obtain pc boards, front panels, kits and components for the projects between its covers.

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MHU26	Ecraft	22dB	75-75	400-860
MH20	Kingray	20dB	75/300-75/300	40-250
MHU20	Kingray	18dB	75/300-75/300	40-860
MH4	Hills	25dB	75/300-75/300	40-250

Distribution Amplifiers Ecraft

Output	Gain	Input Output	Mhz
16-100	100M/v	16dB	75-75 ohm
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27-500	500M/v	27dB	75-75 ohm

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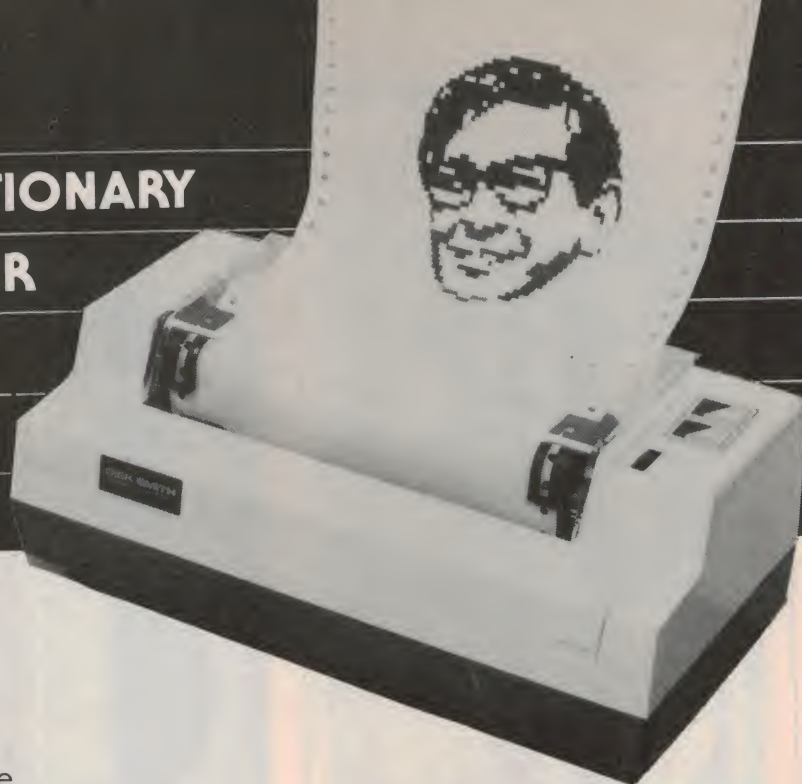
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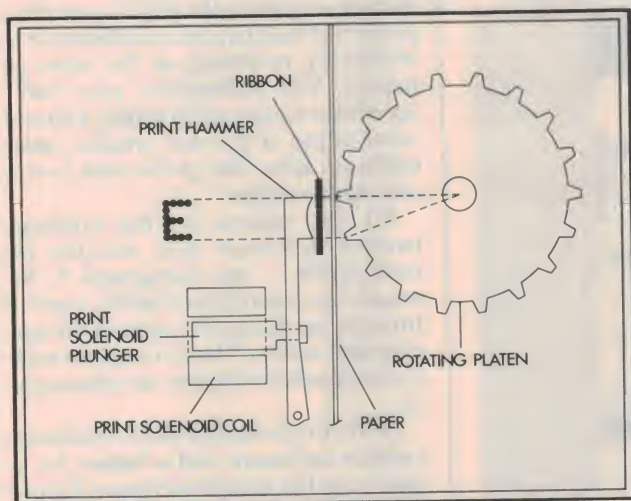


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How the Uni-Hammer Works

The X-3252, which prints both graphics and alphanumerics, uses a rotating platen with protruding splines positioned behind the paper (see diagram). The character or graphics image is created by multiple hammer strikes in rapid succession as the print head advances across the paper. The precision gear train assures exact positioning of the print hammer relative to the splines on the platen, to provide excellent print quality.

A Complete Printer

The X-3252 has features comparable to printers selling for thousands of dollars. These include upper/lower ASCII character sets, ribbon cartridge, 80 columns at 12 characters per inch, adjustable tractor feed, original and 2 copies, 30 characters per second, and full graphics with a resolution of better than 60 dots per inch in both horizontal and vertical axes.

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Series 4000/1

Construction

The boxes were assembled from a high-density panel board called 'panel floor'. The internal volume of the boxes was increased slightly to make room for the volume taken up by the battens and bracing. All panels were cut with a jigsaw. The sides, top and bottom are assembled first by securing battens to the sides. With a little juggling they were glued and screwed and left to dry, being held square by a diagonal piece of wood tacked to the front. I used 1 1/4" (32 mm) by 6 gauge screws, drilled through the panel board into the battens. Drill a 7/64" (2.8 mm) root hole and a 9/64" (3.5 mm) clearance hole for each screw — this enables you to affix many screws without blistering your hands!

Next cut out two identical front panels. Plane each to fit the front of the box. Mark the driver holes in one with a compass and cut out the holes. Cut the driver holes in the second using the first as a template. Take the second front baffle and run a cut with the jigsaw right around the perimeter, about 25 mm or so from the edge — see photograph 1. Note that the cut allows for the woofer lip overhang at the sides and bottom. The rectangular piece left is used later for the grille frame. Plane the outer edges of the now smaller second baffle (to allow the grille cloth to wrap around the edges).

Fit the battens for the midrange-tweeter enclosure next and the first front baffle — see photograph 2. Now attach the second front baffle, carefully lining it up, fixing it in place with epoxy glue and screws. I held it in place with a G-clamp while the glue set (photograph 3).

Next cut the baffles for the midrange-tweeter enclosure and a batten for the bottom baffle of this enclosure. Plane to size for a snug fit. Attach the bottom baffle (photographs 4 and 5 refer). Don't attach the rear baffle of this enclosure yet. Note that I have added braces between the rear baffle of this enclosure and the front baffle of the box, placed either side of the third driver, as can be seen in photographs 4 and 5. Locate, mark and drill screw holes to secure these to the rear baffle of this enclosure.

The plinth on the base is attached next. Note that too much thickness on the piece going across the front of the cabinet will make the crossover



(1)

Two identical front panels are cut and then a cut is made around one about 25 mm in from the edge, allowing for the woofer lip.



(2)

The battens for the midrange-tweeter enclosure are fitted to the box next, followed by the first (larger) front panel.



(3)

The second (smaller) front baffle is attached next — screwed and glued in place.



(4)

Start on the midrange-tweeter enclosure components next.

— a revamp

assembly protrude from the rear of the box.

I put the concrete mix on the rear of the front baffle next. Mix five parts of polystyrene beads (as used in 'bean' chairs) to four parts of sand and three parts of cement. Add a little PVA concrete additive and stir it all until you get a well-mixed, thick, sticky mixture. The internal face of the front baffle was first liberally coated with epoxy resin, which is also run up the sides for about 25 mm. Trowel on the cement mixture until it is around 22 mm thick, while the epoxy is still liquid. The result should turn out like photograph 6.

Horizontal braces are added to the internal baffle and the rear baffle before fixing them in place (see photograph 7). Glue and screw everything. Fill all the screw holes and sand the box down prior to veneering. I also added a brace from the bottom baffle of the internal enclosure to the rear baffle, running right from the front baffle.

Now you can tackle the grille frame. I brazed together a frame to the dimensions of the frame cut from front baffle No. 2, using mild steel strip 10 mm wide by 3 mm thick. This was elevated from the chipboard part of the frame by a sufficient margin to keep the grille cloth a few millimetres or so out from the tip of the dome midrange (driver No. 3). I set some $\frac{1}{8}$ " (3 mm) diameter bolts into the chipboard part of the frame so they protruded far enough, and then cut their heads off. I then drilled $\frac{1}{8}$ " (3 mm) holes in the metal in corresponding positions. I screwed nuts on to each bolt so that only about 3 mm of thread protruded, and placed the metal part of the frame in position, holding it in place with epoxy glue until I could stretch the grille cloth over the assembly.

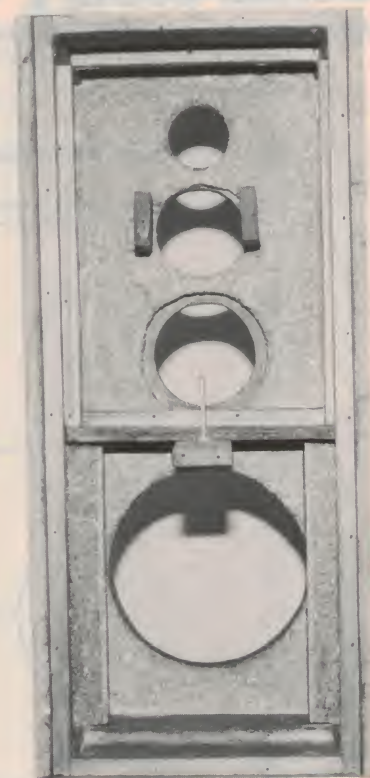
The grille cloth is tacked in place to the rear of the chipboard grille frame.

I added sound-absorbing material to the front baffle before mounting the drivers. It runs from just above the top of the woofer to the top of the baffle. I used upholstery velvet for this job. Before you assemble baffle No. 2 to the front baffle of the box, first lay it on a large sheet of cardboard or paper and trace its outline. This is then used as a template to cut out the velvet to be stuck on the front baffle.

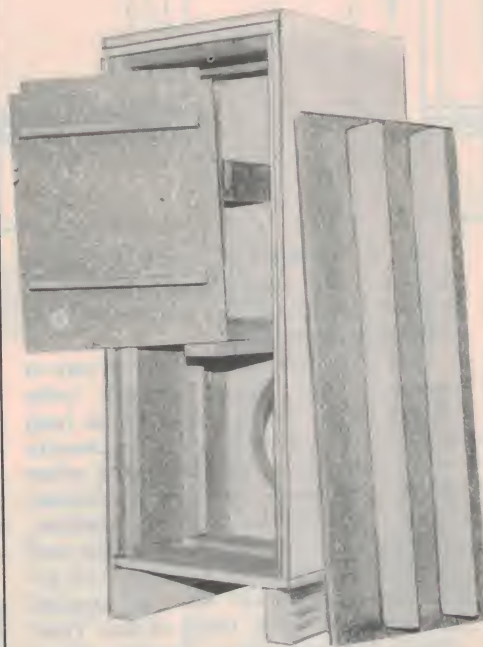
The final result can be seen in photograph 8 and the photograph used on the first page of this article. ►



(5)
Cut the rear baffle for the midrange-tweeter enclosure to size, but don't fit it in place yet.



(6)
The concrete mix applied to the rear (internal face) of the front baffle.

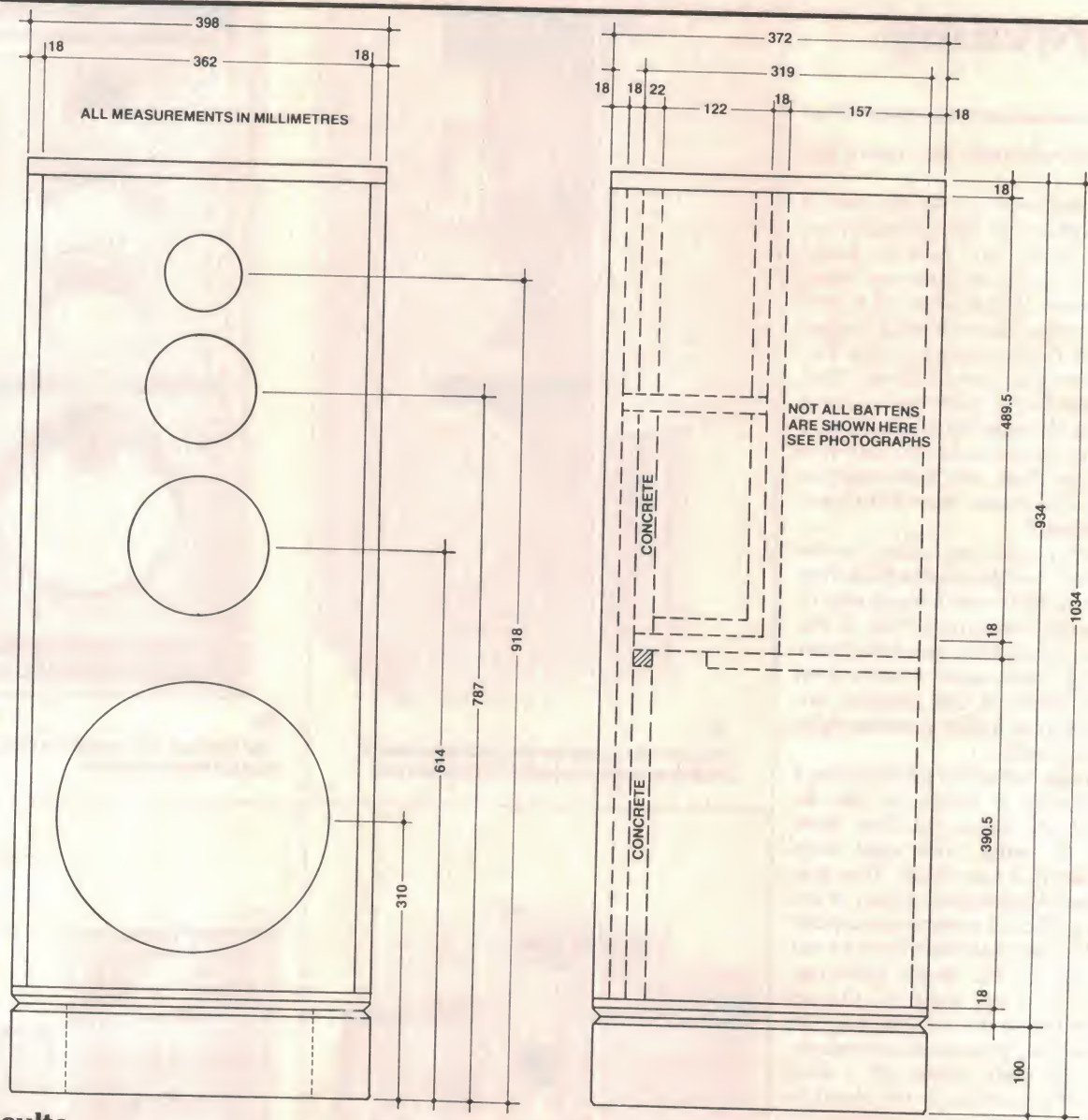


(7)
Horizontal braces are added to the internal enclosure baffle and vertical braces to the rear baffle before assembly.



(8)
The final product! (See also page 131).

Series 4000/1 — a revamp



The results

After four weeks of solid work, the time came to connect them up.

When I talk about differences I am referring to my old favourite 439 speakers. The first reaction on listening to Sky II, as the volume was advanced from a low level to a comfortably realistic one, was that they were just another set of good hi-fi speakers, the bass level being more prominent. Further listening revealed that there were *definite* differences; the trouble is working out whether there is an improvement or just a difference. A-B testing was not possible, but listening to well-known and liked albums, one can notice differences by comparing previously remembered musical impact.

As I listened to many favourite albums, the superb performance of these units gradually became evident, strikingly so at times.

One of my main hopes in a new pair of speakers was more accurate voice sounds. The 4000-1 give this on both male and female vocals, with extremely real definition to sibilants and other throat and nasal aspects of the human voice. Transient attack is excellent, offering brilliant attack to drums and cymbals, also trumpets. I could not, for instance, previously see the musical merit of the 'Tusk' track of the 'Tusk' album, Fleetwood Mac. The bass attack and clarity of the 4000-1 made me realise the sonic experience the producers must have been trying to achieve. On fortissimo passages of the 'Planets', an RCA record with Andre

Previn conducting the London Symphony Orchestra, I was able to follow the tuba passages in amongst other bass instruments.

The 'Windchase' track from the same-name Sebastian Hardy album is one of my favourites. I am able to drift into the space known as the stereo image more easily, noticing subtle ambient details in the recording studio, even during sustained loud passages. This, I believe, could be due to lower distortion.

It is strange how much imagination plays in my music perception. On some less listened to albums I had listened for, or tried to emphasise in my mind, instruments on particular tracks. With the 4000-1 speakers these mistakes are less easy to make. This fully justifies all the effort put into constructing them. ●

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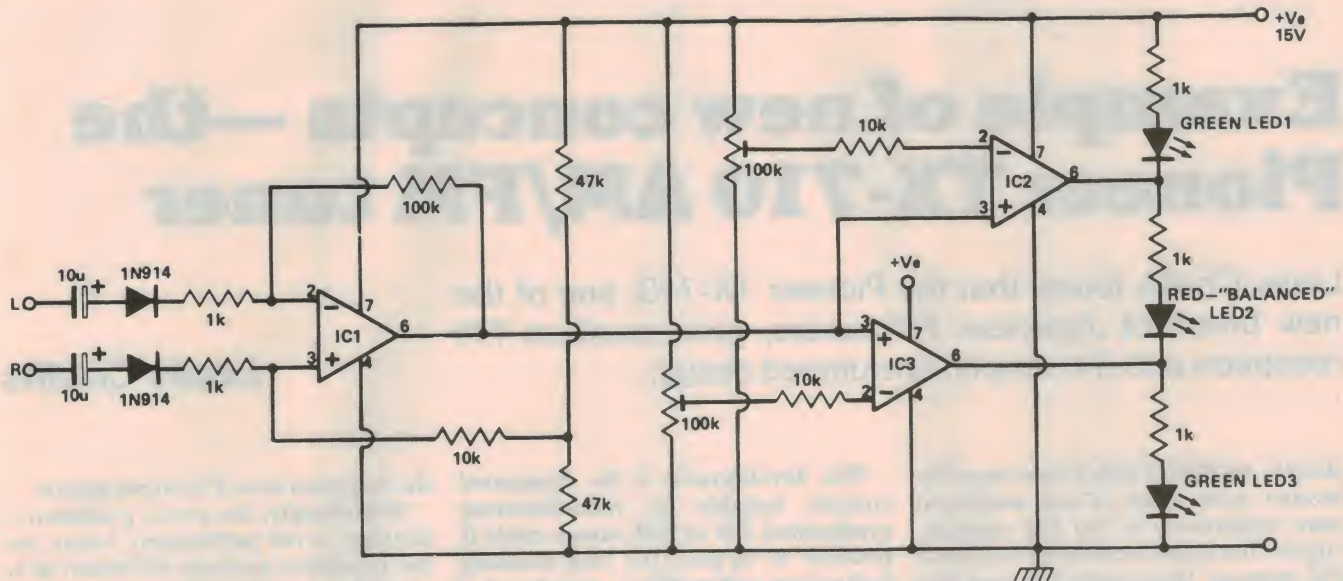
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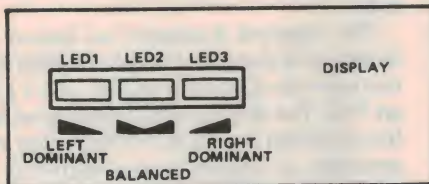
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NOTE:
IC1, 2 & 3 ARE 741
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Stereo balance meter

G. Durant

BALANCE on a stereo amplifier is usually set by ear, but this of course can be very difficult to judge. If an amplifier has a balance meter at all, it is usually of the centre-zero moving coil type — bulky, old-fashioned looking and expensive. This circuit is designed to overcome all of these problems.

The outputs from each channel are fed to the two inputs of IC1, this being connected as a differential amplifier. If the left and right channels are of equal levels, the output of IC1 will have its output about halfway between the supply rails. If the left channel gets above the level of the right channel, the output of IC1 will approach the 0 V rail. If the right channel is loudest, the output becomes positive.

IC2 and IC3 are also differential amplifiers, but in this case they are driven by the output of IC1. LEDs form a display at the outputs of the two ICs.

Pin 2 of ICs 2 and 3 each go to a preset across the supply. In practice the preset in conjunction with IC2 is set to hold pin 2 slightly above 0 V and the preset connected to IC3 is set to hold pin 2 just below supply voltage. These settings, however, must be set by trial and error so that the circuit works accurately.

The output of IC1 is connected to the non-inverting inputs of IC2 and IC3. If the output of IC1 approaches the supply rail, the outputs of ICs 2 and 3 would be low, thus illuminating LED1. If the two channels were equal in amplitude, the outputs of ICs 2 and 3 would be high and low respectively, lighting up LED2.

The circuit can easily be added on to a ready-constructed unit without using up large amounts of panel space, or used as an add-on unit for a hi-fi system. The unit draws about 20 mA, so battery operation is practical.●

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Example of new concepts —the Pioneer TX-710 AM/FM tuner

Louis Challis found that the Pioneer TX-710, one of the new breed of Japanese FM tuners, gave excellent FM reception out of a simple, uncluttered design.

Louis Challis

MANY AUSTRALIANS have recently become more aware of and attributed more importance to the FM medium, largely due to the increase in number of FM stations. Many radio listeners who formerly would not have considered buying an FM receiver now regard it as worthwhile, there being a wide choice of stations with programmes catering for most tastes — classical, pop, rock and background music.

Most audiophiles are aware of the type of conventional FM receivers that used to be manufactured, but I doubt if many really know or understand the implication of what has happened to the design of FM tuners (or receivers) over the last two years. In that time the Japanese manufacturers have developed a wide range of new integrated circuits whose power, potential and cost have upstaged design concepts nowhere more than in the area of FM receiver design.

The new breed

Conventional FM receivers were previously designed with discrete components in the radio frequency and local oscillator stages. These incorporated conventional butterfly-type capacitor tuning gangs, expensive slide rule frequency tuning dials, and a major part of their cost was dominated by the mechanical hardware required for their operation. The majority of these tuners offered good performance, but generally with a price to match.

From the typical Japanese manufacturer's standpoint they constituted a pain in the proverbial **** as in their fabrication they required considerable expensive manual labour — a positive no-no in Japan today.

The development of the integrated circuits suitable for manufacturing synthesised FM or AM tuners made it possible to by-pass the long-standing technology and produce a new breed of tuners with other important attributes. These tuners replaced the slide rule dial with a digital frequency display, and the large scale integrated circuits offered the alternative solution that most Japanese manufacturers had long sought. The real advantage of these tuners came as a result of the manufacturer's ability to simplify or discard the bulk of that mechanical hardware.

The new generation of receivers bears little resemblance to the old generation and to the untrained eye they even give the appearance of cheapness, as they appear to contain very little in the way of components. In reality what they contain is some of the most complex electronics available in consumer electronics, but this complexity is hidden in large scale integrated circuits with as many as 42 pin connections which are veritable mini computers in their own right.

Features

The appearance of the Pioneer TX-710 synthesised stereo tuner is deceptively simple. It comes in a small, light, neat package featuring a brushed satin aluminium fascia, the front panel incorporating an inset display on the upper right hand side of the unit, with the minimal number of controls laid out in a row below. The display contains five green rectangular LEDs to display the signal strength. These provide indication at signal strength of 20, 30, 35, 39 and 48 dBf respectively. Another red rectangular LED is provided to indicate

the reception of an FM stereo station.

Surprisingly, the actual gradation of settings is not particularly linear and the handbook gives no indication as to what the intended settings were meant to be.

The selected frequency is shown by means of a five-digit display which has increments of 50 kHz on FM and 1 kHz on AM. The display also shows whether the selection is an AM or FM station and provides a display whose legibility is extremely good under almost any light condition.

The bottom row of controls consists of a rugged power on/off toggle switch on the left hand side of the unit, immediately below a red bezel light, and nine touch switches with their own green LEDs centrally located on the bottom of the fascia.

The first of these switches is for the FM local sensitivity threshold level, which comes into play in the auto tuning mode at an input signal strength of 50 dBf, compared with the normal capture capability of 25 dBf. The next switch is the memory activation switch, which, when depressed before selecting one of the switches 1-7, stores the frequency of the station which is displayed at that time.

Unlike some other tuners with internal memories, this unit does remember the stations selected, on both FM and AM, even when the unit has not been used for a week or more or when disconnected from the mains.

Two other toggle switches at the right hand end of the dial are for selection of FM and AM and the adjacent switch is the FM mode switch which, when in the auto position, will switch the reception to stereo if the pilot tone carrier is



detected and to mono if it is not. In the mono position this switches the incoming signal automatically to mono, a necessary feature with low strength signals. The two remaining controls at the extreme right hand end of the panel are downward and upward touch buttons which initiate an automatic frequency scan for a signal with sufficient strength to activate the automatic frequency control circuit. Obviously if the signal strength is too low, then the receiver will not lock on to the station and will continue its frequency scanning until it finds a station with suitable signal strength.

The rear of the receiver is particularly sparse and incorporates a 900 mm long, permanently wired output cable with two type RCA coaxial plugs on the end instead of the normal panel-mounted coaxial sockets. The aerial output requirements are met by a 75 ohm coaxial socket for connecting

the FM aerial, together with screwed terminals for both 300 ohm feeder connection and external AM antenna inputs.

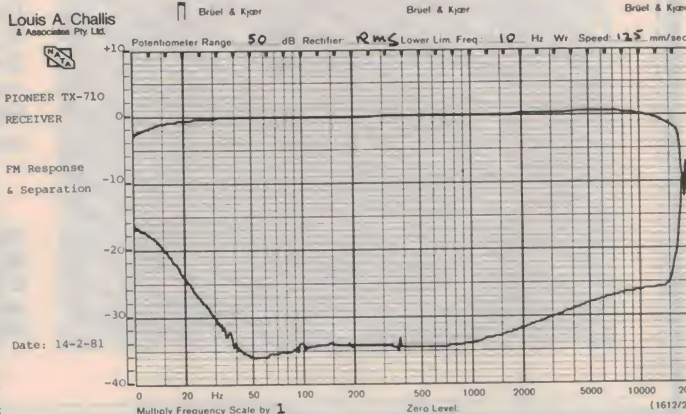
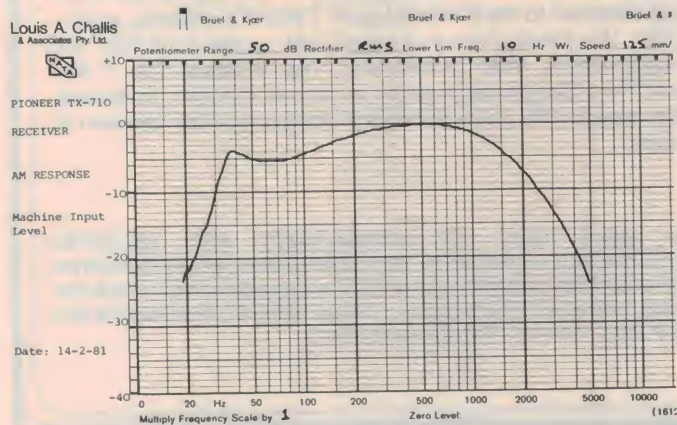
A conventional loopstick antenna is also provided, which incorporates a very effective universal joint to orientate the rod in a wide range of possible positions for optimum reception of local stations.

Inside the tuner

The inside of the tuner is remarkably simple compared with other tuners that we have recently seen. It makes use of one large mother board with nearly all the components mounted on it. The two exceptions to this are the power supply, which is mounted on its own separate board, and the frequency counter, the function indicator integrated circuits and the signal level indication drive ICs, which are mounted on a printed circuit board located behind the front panel.

The designers have gone to unusual lengths to provide all interconnections by means of flat ribbon cables, the majority of which are not colour coded. These ribbon cables are long and wide and even interconnect the power supply board to the mother board. Although one would expect them to provide a neater appearance, because of the way they are rolled over under the metal cover of the tuner, they detract a little from the otherwise neat appearance.

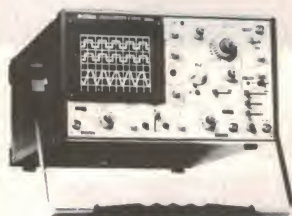
The FM tuning section is provided with a small separate electrostatic screen, but apart from this you could be excused for not knowing that you were looking at an AM/FM receiver. The chassis is of lightweight steel construction, as is the cover, and is about as utilitarian as one could hope for. It provides simple but effective support and encapsulation for what is undoubtedly a very cleverly designed tuner.





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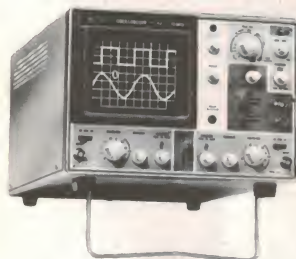
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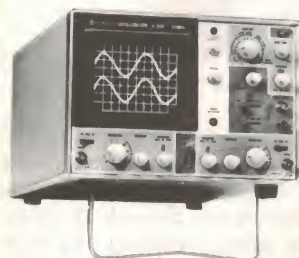
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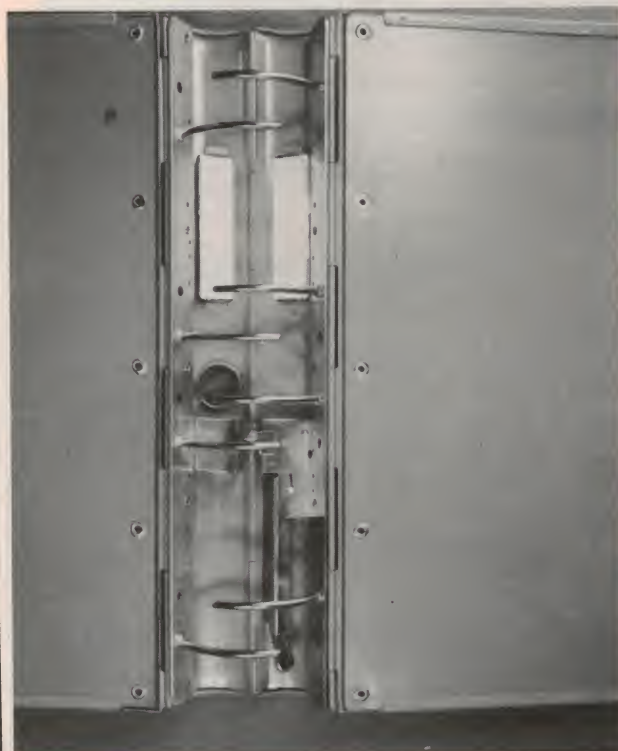
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On test

The objective testing of the unit's performance reveals that the unit has lost little in the way of desirable characteristics as a result of the changes in design philosophy.

The most important parameter is undoubtedly the FM sensitivity, which is 16 dBf for 26 dB signal to noise ratio on mono and 31 dBf for 46 dB signal to noise ratio on stereo. The mono figure is not quite as good as the manufacturer claims, whilst the stereo figure is slightly better. The signal to noise figures are, however, exactly as claimed by the manufacturer and the frequency response is almost exactly the specification figures quoted.

The channel separation is better than 36 dB at 1 kHz and is certainly better than 25 dB at all frequencies between 20 Hz and 16 kHz. Overall the FM tuner section provides very clean performance that is well up to the needs of most fastidious listeners. By contrast, the AM tuner section has a frequency response of 35 Hz to 1.6 kHz and is typical of the poorer AM tuners that we have recently seen. The sensitivity of the loop antenna is 300 microvolts per metre and this is only just good enough for local reception. In poor signal strength areas in the major Australian cities this would require the supplementary connection of a trailing wire antenna to provide sufficient signal strength for acceptable reception.

The subjective performance of the tuner on FM is remarkably good. I listened to a wide range of FM programmes at home for over a month and found that its performance was truly excellent (and that the FM stations in Sydney are improving with age). Whilst its overall sensitivity is not quite as good as some of the other expensive tuners we have recently reviewed, its ease of tuning and the quality of the signal it produces are every bit as good. With only a simple folded dipole in my home, which is not in a particularly good signal strength area, all seven of Sydney's FM stations were received with adequate signal to noise ratio and generally better than 50 dB, during both day and night.

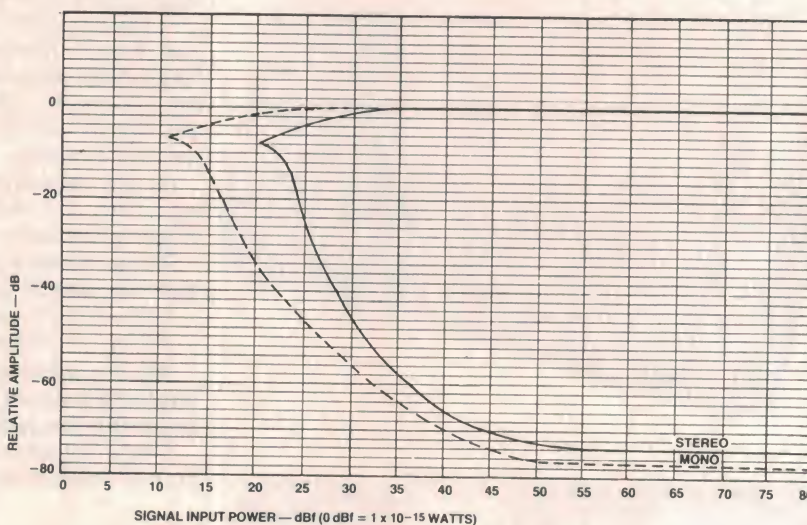
By contrast the AM reception with just the loop antenna falls short of a fully adequate performance and is further marred by the narrow band width of the AM section's intermediate frequency stage. Whilst the AM section is good enough for listening to the news,

it is, in my opinion, unsuitable for listening to music and is only little better than telephonic reception.

The TX-710 synthesised tuner has many attributes, the most important being the quality of its FM reception, its ease of usage, and the simplicity of its design. Given a reasonable aerial it provides excellent FM reception and would undoubtedly be an asset to anyone wishing to enter into the realm of FM reception or who is thinking of discarding an older and less effective FM tuner.

Dimensions: 420 mm wide by 94 mm high by 270 mm deep
Weight: 3.3 kg
Manufactured in: Japan by Pioneer Electronic Corporation
Price: \$329
Distributed by: Pioneer Australia Pty. Ltd.

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FM TUNER SECTION (measured at 98 MHz unless otherwise stated)	
FREQUENCY RANGE	85.8 - 109 MHz
USABLE SENSITIVITY (40 kHz deviation)	
Mono for S/N 26 dB	16 dBf
Stereo for S/N 46 dB	31 dBf
SIGNAL TO NOISE RATIO (see curves) (40 kHz deviation)	
Mono	77 dB
Stereo	74 dB
FREQUENCY RESPONSE (see curves)	10 Hz - 17 kHz
SEPARATION (see curves) (includes generator)	> 34 dB
CHANNEL BALANCE	0.2 dB
OUTPUT VOLTAGE	(at 1 kHz, 40% modulation) 260 mV
OUTPUT IMPEDANCE	(at 1 kHz) 1 kohm
AM TUNER SECTION	
FREQUENCY RANGE	492 - 1660 kHz
ANTENNA	Ferrite Rod
FREQUENCY RESPONSE (see curves)	@ 6 dB Point 37 - 1600 Hz
CHANNEL BALANCE	0.2 dB
OUTPUT VOLTAGE	(@ 1 kHz 40% modulation) 260 mV
OUTPUT IMPEDANCE	(@ 1 kHz) 1 kohm
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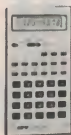
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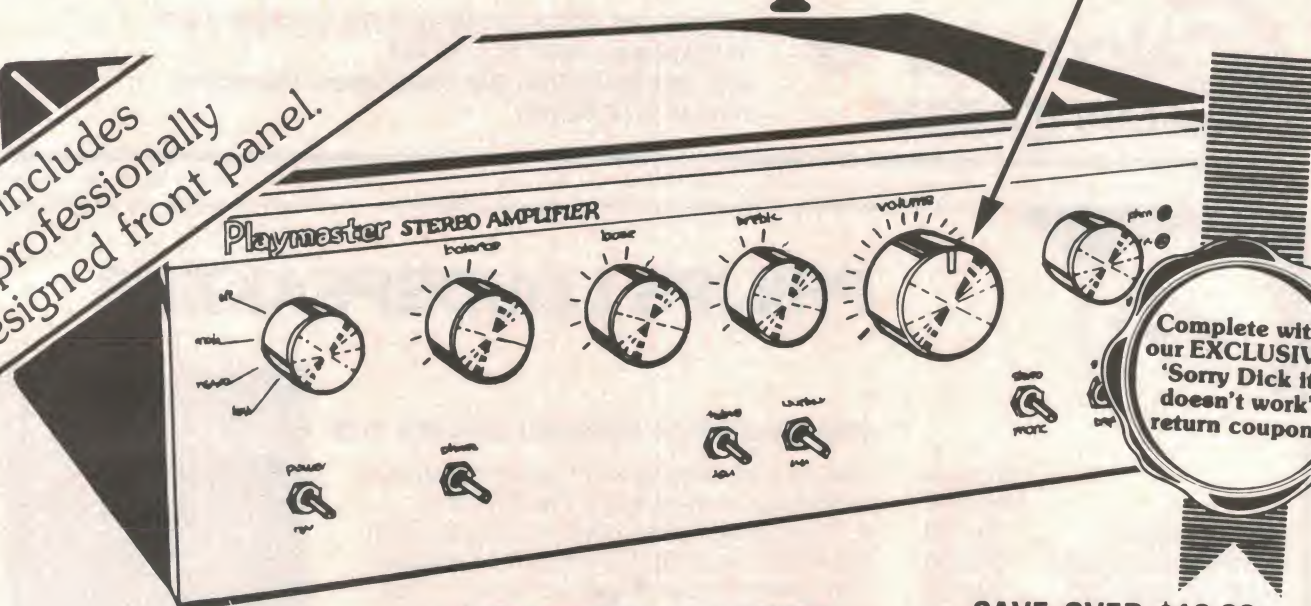
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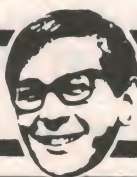
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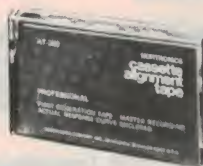
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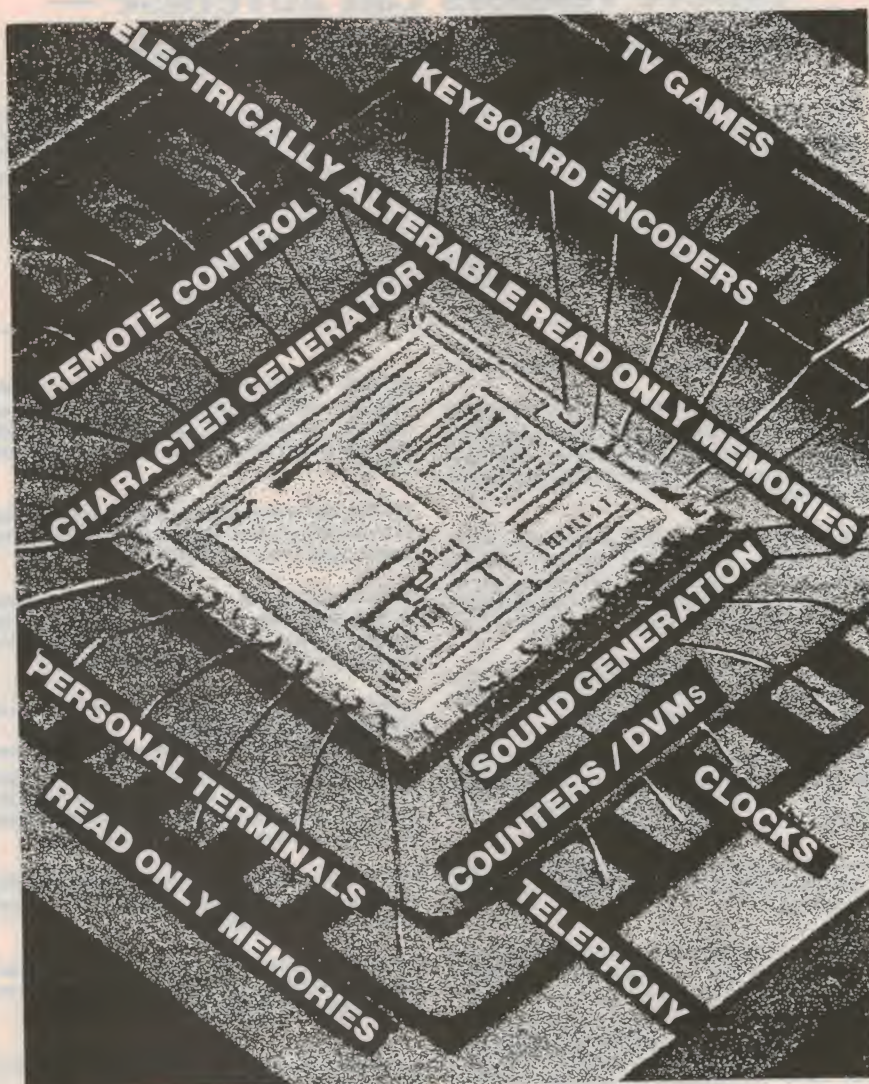
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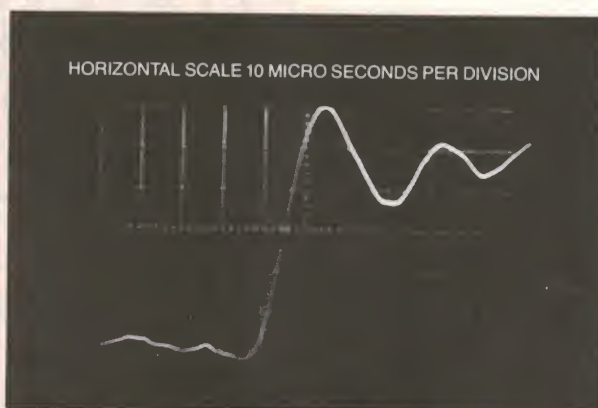
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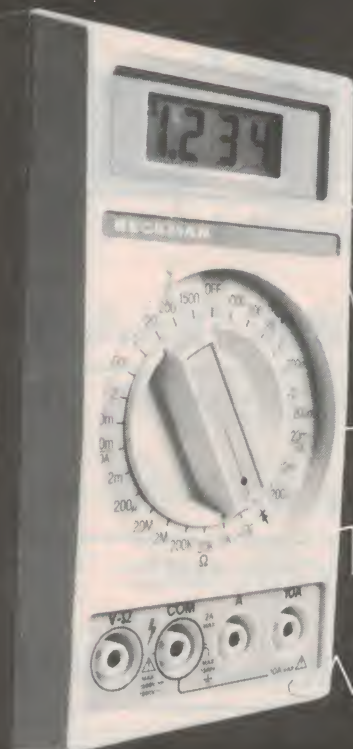


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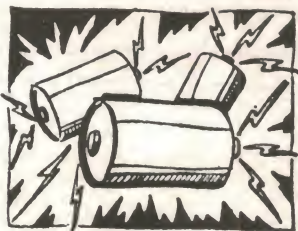
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DREGS



'THE best laid plans of mice and men gang aft agley ...' said Robert Burns. That little gem is a literary refinement of Murphy's law, of course. It sprang to mind when Gary Johnston of Jaycar showed us an item from the Sydney Sunday paper, the Sun Herald, of April 26. Margaret Sydney runs a column of helpful household hints called 'You Say, We Pay'. Every week she has a number of Star Hints. The April 26 item is reproduced below — without further comment!



● If you intend to store batteries in the freezer (for longer life), make sure you wrap them well in foil to keep moisture out.

Penultimate pun-star?

Well, the computer punsters were out in force in an all-out effort to "have the last byte" at the Great Dregs Pun Competition, as Mike Scott of Palm Beach said, who sent two puns, but ...

P.J. Crawford of Glenhuntly in Victoria sent several; here's a sample — 'Don't say watt, say pardon!' Wayne Brown from Dromana in Victoria sent, 'Is a pull-up resistor an electronic policeman?' and Greg Bond of Cranbourne South (another Victorian!) sent one too long to publish. Sorry, Greg.

Our lucky final winner sent the following story: Two design technicians in a large electronics firm had just finished prototyping their new dot-bar graph driver display. The board included only an IC and a handful of LEDs. All connections were accomplished cheaply using small wire bridges. Said one to the other, "It's nothing but the bare necessities. But what shall we call it?"

His mate replied, "How about ... bridge-it bardot!"

It certainly raised the most groans around the office! A copy of Test Gear Vol. 2 is on its way to Michael Carden of Belgrave South in ... you guessed it, Victoria!

That's it, no more — try our new competition.

(Incidentally — 'penultimate' means: the last but one. That's right, we're going to have the last pun-say. Watch for the story of Elmo and his Stratocaster in a forthcoming issue!).

New competition!

Even the very best of editors (i.e: past and present editors of ETI) have just occasionally been known to err. Our erudite managing editor has pointed out to Roger Harrison that his sub-heading on page 83 in May ('Play it again, RAM'), whilst amusing, was misquoted. Nowhere in the film 'Casablanca' does Bogart say "Play it again, Sam". Closest is Ingrid Bergman's "Play it once, Sam, for old time's sake". Later in the film Bogart says, "You played it for her, you can play it for me. Play it."

Before you all laugh **too** hard here are 15 well-known quotations. Every single one is incorrect. We're offering a couple of prizes to the first two readers to send us:

- a) the corrected versions — if such exist.
- b) the origins of the (correct) versions.

1. Elementary, my dear Watson.
2. We are the masters now.
3. Come up and see me sometime.
4. Money is the root of all evil.
5. I knew him well, Horatio.
6. Survival of the fittest.
7. I want to be alone.
8. The stuff that dreams are made of.
9. To gild the lily.
10. I must go down to the seas again.
11. First catch your hare.
12. Lead on, Macduff.
13. Pride goeth before a fall.
14. All that glitters is not gold.
15. Thou shalt not kill — but needst not strive officiously to stay alive.

On the basis that every right-minded reader already takes ETI regularly, we are offering two subscriptions to our competitive (competitive? — Ed) magazine, Electronics Australia.

First prize — one year's subscription to EA.

Second prize — two year's subscription to EA.*

(*No, we haven't got that wrong!)

Send your entries to Dregs' Quotes Competition, ETI magazine, 15 Boundary St, Rushcutters Bay NSW 2011.

UNTIL WE DEVELOPED THE STEREO GROOVE, HI-FI WAS PRETTY HO-HUM!



The world of hi-fi owes a lot to the original and continuing innovation of JVC. Few companies, if any, have done as much to help turn records and record-players into the virtual musical instruments they are today... or to lead the way in developing so many *firsts* in the more recent concepts of sound amplifiers, cassette decks and computer-designed speaker

systems. Hi-fi, as we know it today, had its beginnings in 1956, with JVC's development of the 45°/45° groove for stereo records. The fact that this system still remains as the world standard is, in itself, outstanding testimony to the technology of JVC. The development revolutionised not only the record-making industry, in which we've been involved since 1930; it also paved the way for enormous advancement in the design and engineering of record-playing equipment. Now, hi-fi has expanded to



R-S77. Super-A FM/AM Stereo receiver

embrace a wealth of highly-sophisticated electronic equipment; and it's not surprising that JVC has continued to play a leading role in so much of its development.



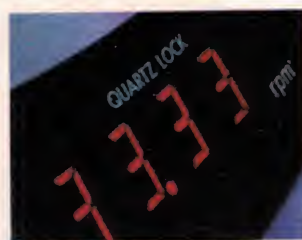
HR-3660 EA. VHS Colour Video Cassette recorder

THAT WASN'T OUR ONLY FIRST, EITHER.

We also pioneered Japan's television industry, introducing their first TV receiver just over 40 years ago. A more recent innovation is VHS, the home video recording system now gaining world-wide acceptance as *the* system for such equipment. In the course of staying ahead, we've introduced a number of world *firsts* of radical importance: the Quartz Lock turntable is one of them.

THE QUARTZ LOCK TURNTABLE. MANY TIMES MORE ACCURATE.

It stands to reason that if your equipment is at the top end of the range, then your turntable must be capable of comparable performance. Only Quartz Lock ensures this, tying the speed of the turntable to the unvarying pulse of the atom, and providing a level of accuracy far in excess of conventional turntables.



MORE MILESTONES IN HI-FI.

To match the superb quality of Quartz Lock, we produced the S.E.A. graphic equalizer system. Then we refined it to such a degree it even compensates for the effect your furniture has on sound when it leaves the speakers! To expand the capabilities of tape, we designed ANRS and



SEA-80. Stereo Graphic Equalizer

Super ANRS — automatic noise reduction systems which not only reduce distortion and 'hiss' but actually extend the dynamic range of the tape. Similarly, with speakers: at JVC we employ computers in their design to help provide the ultimate in sound reproduction.

AND NOW, SUPER-A.

In its own way, as significant a hi-fi development as the stereo groove. Imagine an amplifier which combines the *best* features of the two recognised amplifier classes (A and B)... an amp which combines the *efficiency* of one with the *low distortion* of the other. Some engineers said it couldn't be done; but not those at JVC. Enter the Super-A amplifier... the *latest JVC first!*

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the right choice

THE FUTURE.

It's already with us. For instance, we were so far ahead in the new metal tape technology that our cassette decks were metal-compatible before the tapes were generally available. And now there's the JVC Electro-Dynamic Servo Tonearm, damping tonearm resonance by means of a purely electronic system and two 'thinking' linear motors. Who was it who dubbed JVC, 'the innovators'?



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